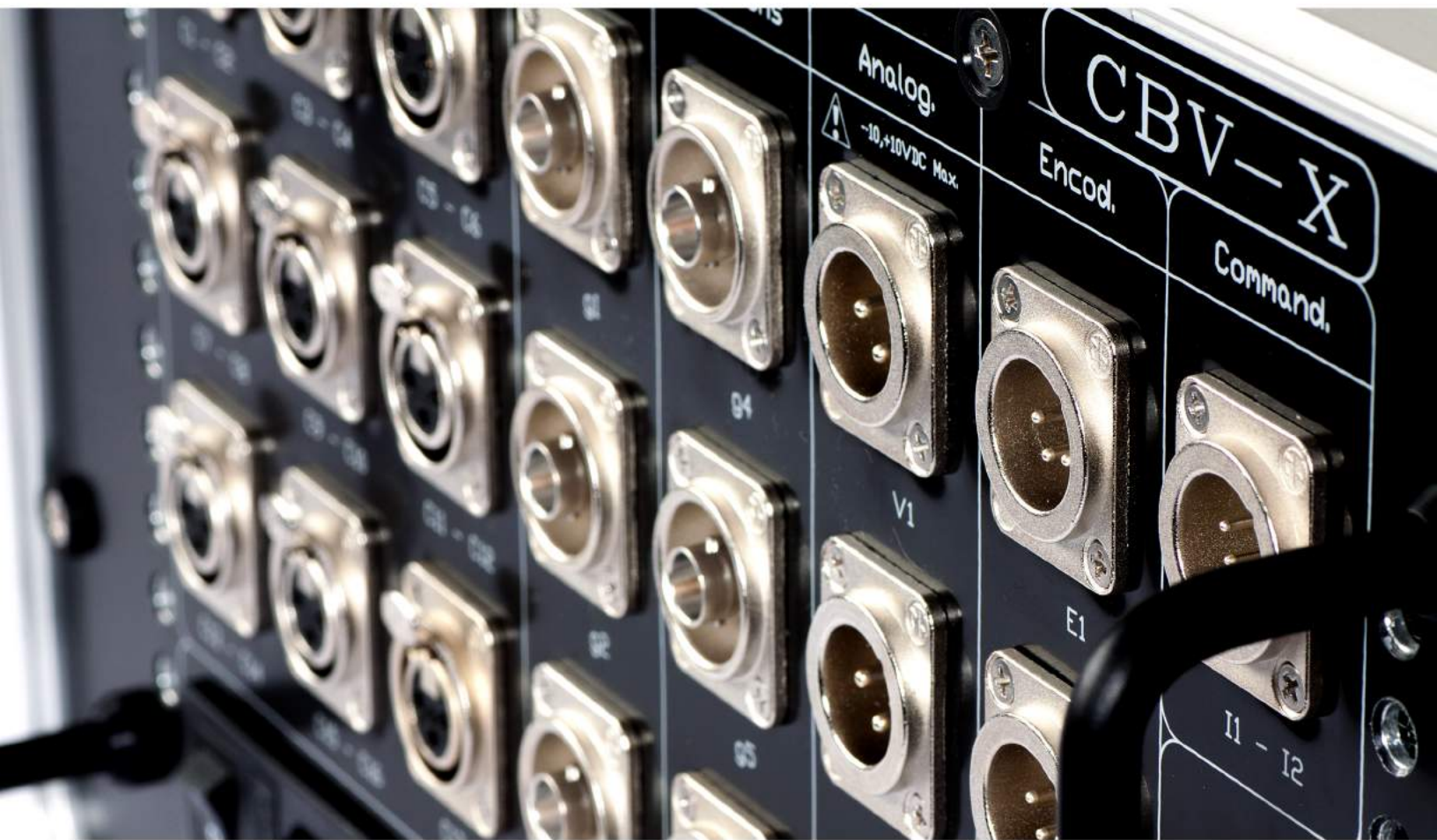


ZENSOL

WWW.ZENSOL.COM



HIGH VOLTAGE
CIRCUIT BREAKER
DIAGNOSIS

The goal of this booklet is to show you our complete solution for your circuit breaker diagnostic. This solution, first developed by Zensol over 20 years ago, is in constant evolution.

Zensol is the leader in applying the vibro-acoustic method applied to circuit breakers. Our instruments have allowed the implementation of this method at Hydro-Québec, a world leader in hydroelectricity. As it gains in popularity and respectability, our method spreads more and more around the world.

Thanks to this method, you will succeed in detecting many mechanical problems in your circuit breakers, which cause more than 40% of all failures (Rep.No.83, 1994). Classic tests such as timing, motion, static and dynamic contact resistance are often unable to find these mechanical problems, thus the reason to use the vibro-acoustic method.

Circuit breakers are very important and highly used components that protect the electrical network and any apparatus connected to it. Adequate preventive maintenance greatly reduces the possibility of serious consequences and the associated loss of revenue.

Your guide to circuit breaker diagnosis

In this booklet you will find details about our circuit breaker analyzers, the CB11, CBA-32P, OTM-XB, SIM-CB6 and especially the CBV-X, the only analyzer in the world capable of performing timing, motion, vibration and dynamic contact resistance testing in a single operation. Our systems are compatible with all our software and accessories. You may use them on any circuit breaker type, from 3 to 30 contacts and from low to high voltage (800 kV).

The software and various cables and accessories needed for our instruments will also be shown. Finally, the services offered by Zensol, and provided by experts, will be detailed, including data analysis, field testing services, as well as training and seminars.

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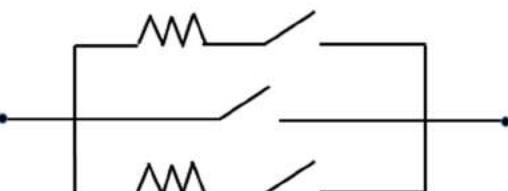
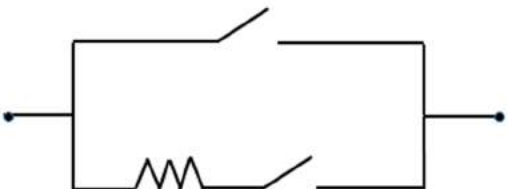
What is a circuit breaker?

It is an electromechanical device that interrupts the current under normal service conditions such as disconnecting loads on the network, and under abnormal conditions such as current overloads or electrical faults. Depending on its design, various

circuit breaker technologies are used, according to the voltage level and insulating medium utilized. The interruption of the current occurs in the breaking chamber, in an insulating medium such as air, oil, SF6 gas or even a vacuum.

To ensure proper operation of a circuit breaker throughout its lifetime, tests must be performed. In case of a failure, repair costs may reach hundreds of thousands of dollars. That's why it's essential to prevent failures before they happen.

SYMBOLIC CONTACT SCHEMATIC



What is a control cabinet ?

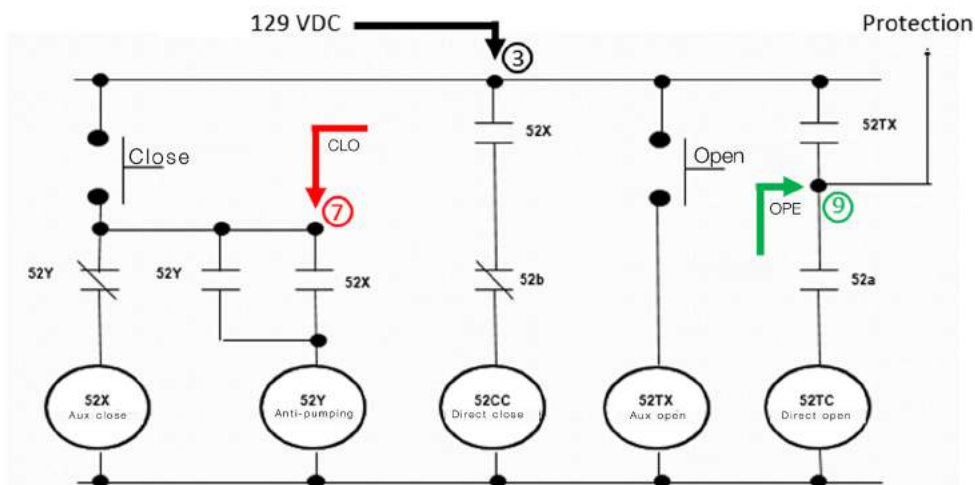


The control cabinet may be considered as the brain of the circuit breaker. All close and open commands are issued by this device.

Indeed, these operations are triggered by an electrical pulse only a fraction of a second long, applied to a coil in the command mechanism. This amplifies the order and transforms it into a circuit breaker operation by freeing the required energy, previously stored in energy accumulators, to perform the breaking or closing action.

The components of a given manufacturer's control cabinet depend on the design voltage and the interrupting technology used by the circuit breaker. Typically, one finds control relays, coils and command buttons, an alarm and the power circuit.

SYMBOLIC
CONTROL
CABINET
SCHEMATIC



Anomalies detected by the vibro-acoustic method

OUR VIBRO-ACOUSTIC METHOD

Circuit breakers generate vibro-acoustic signatures when they operate. Our method, developed and tested in the field, in partnership with Hydro-Québec for over 20 years, can determine the state of health of a breaker thanks to these “sounds”!

WHY ?

- Non-intrusive method
- Determines a circuit breaker's state of health
- Detects problems that classical methods cannot

WHEN ?

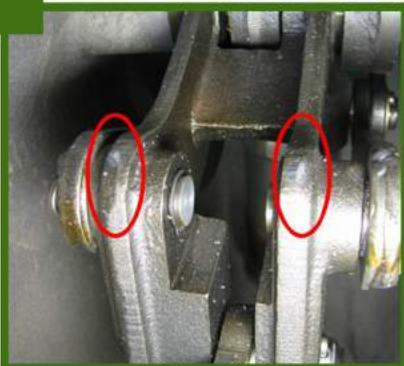
- During an intervention on a breaker, before and/or after servicing

HOW ?

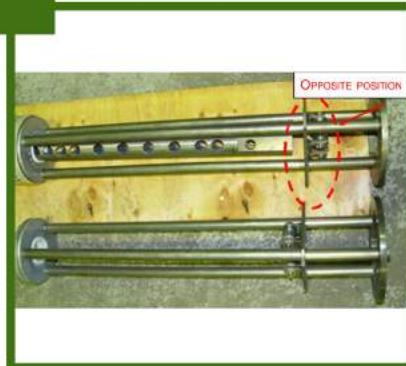
- Using one or more piezoelectric accelerometers mounted on each phase of the circuit breaker

WHAT ANOMALIES ?

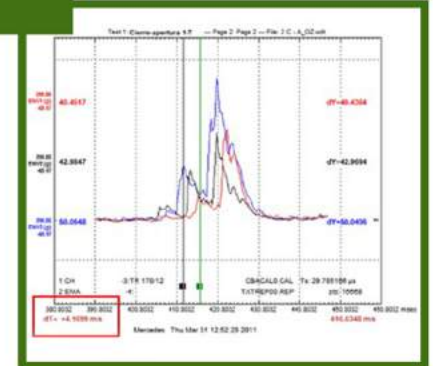
ADJUSTMENT



ASSEMBLY



SYNCHRONIZATION



TEST	ADJUSTMENT	ASSEMBLY	SYNCHRONIZATION	UNSCREWING OR FAILURE OF THE COMMAND MECHANISM	UNSCREWING OF A CONTACT	LOW OIL LEVEL
TIMING	✓		✓			
MOTION	✓					
DYNAMIC RESISTANCE	✓					
VIBRO-ACOUSTIC	✓	✓	✓	✓	✓	✓

CBA/CBV/CB/OTM-XB

COMPLETE SOLUTION
CIRCUIT BREAKER DIAGNOSIS



All our instruments

are compatible with

all our accessories

and work with

all circuit breakers

CB11

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ACCELEROMETERS

p45



220 kV



330 kV



735 kV

Over 25 years of experience building portable instruments !

STRONGLY BUILT

- Our instruments have a lifetime of over 15 years;
- Thanks to an efficient design, our units are the only ones able to withstand shocks and drops without damage;
- Reinforced polyethylene case with molded ribs for maximum protection;
- No fragile built-in components such as printers, screens or keyboards;
- Simple and sturdy connections.

STRONGLY BACKED

Zensol offers many types of technical support;

- Software support;
- Field testing assistance;
- Internet support available;
- Training available;
- Support fully available for our customers.



CB11

CIRCUIT BREAKER ANALYZER



What is the CB11 ?

The CB11 is a 3 contacts circuit breaker analyzer designed to measure timing, motion and static & dynamic contact resistance in a single test. It has also 3 multifunction analog inputs and an optical encoder input.



Detected problems	Test method	CB11		CBA-32P		CBV-X		OTM-XB	
		Online	Offline	Online	Offline	Online	Offline	Online	Offline
Contact timing	Timing test		✓		✓		✓		
Contact bounce	Timing/motion test		✓		✓		✓		
Bad damping	Motion test		✓		✓		✓		
Main contact wear	Micro-ohmmeter test		✓		✓		✓		✓
Arcing contact wear	Dynamic resistance test		✓		✓		✓	✓	✓
Open and close coil assessment	Coil current test	✓	✓	✓	✓	✓	✓	✓	✓
Motor assessment	Current and voltage test	✓	✓	✓	✓	✓	✓	✓	✓
First trip	Measure current over 3 phases	✓		✓		✓	✓	✓	✓
Bad mechanical adjustment	Vibration test					✓	✓	✓	✓
Bad alignment	Vibration test					✓	✓	✓	✓
Bad contact timing	Vibration test					✓	✓	✓	✓



The little guy that plays along with the big boys !

You are able to test any type of circuit breaker with accurate and efficient performance, even in voltage ranges of up to 800kV.

Competitively-priced solution that is able to perform all tests required for proper maintenance

You will have an optimal **QUALITY**, **SPEED** and **ACCURACY** for all your tests

Sampling time : 5 μ s.

Sampling rate : 200kHz.

You will be certain to ensure operator **SAFETY**

You will be amazed how compact and lightweight the CB11 is.

Technical specifications

CB11

www.zensol.com www.zensol.net

RECORDING CHARACTERISTICS

Sampling time: 10 μ s to 26 ms
Sampling rate: 38 Hz to 100 kHz
Recording time: 10 ms to 30 min
A/D conversion: 16 bits

DIGITAL INPUTS FOR DRY CONTACTS (3 states)

Number available: 3
Contact power supply: 40 VDC
Resistance range: 500 kV Closed ($r < 30 \Omega$)
Preinsertion: ($30 \Omega < r < 4$ or $7 \text{ k}\Omega$)
Open: ($r > 4$ or $7 \text{ k}\Omega$)

Each input detects both main and resistive contacts;
Each input may also be used to measure auxiliary (a/b type) or any other dry contacts.

DIGITAL INPUTS FOR WET CONTACTS (2 states)

Number available: 2
Response time: 5 μ s (rising) / 40 μ s (falling)
Input voltage: 0-300V AC/DC
Switching voltage: 50 V DC

MULTIFUNCTION ANALOG INPUTS (16 bits)

Number available: 3
Resolution: 16 bits conversion A/D
Accuracy: +/- 0.3 mV
Input voltage range: +/- 10 VDC (compatible with all industrial transducers)

DIGITAL INPUTS FOR OPTICAL ENCODERS (16 bits)

Number available: 1
Resolution: 8000 pulses/revolution
Type of transducer: incremental
Automatic reset to zero before each test.

COMMAND OUTPUTS / CURRENT INPUTS

Command outputs: 2 completely independent contractors (close and open, able to break up to 30A at 300V AC/DC)
Current inputs: 2 integrated and independent current transducers (in series with the two contractors)
Software selectable current ranges: +/- 20A +/- 10A +/- 5A +/- 1A
Note: Hall effect current transducer needs no shunt to measure current !

IMPORTANT NOTE : All CBA/CBV accessories (cables, transducers, adaptors, etc.) may be used with the CB11.

ANALOG INPUT TESTS

Static contact resistance test - main contact:
KIT MO-SD 100/200 (1 micro-ohm to several ohms)

Dynamic Contact Resistance Measurement- DCRM - Arcing contacts:
KIT MO-SD 100/200 (1 micro-ohm to several ohms)

First trip test:
Z-FT (AC current clamp: 100 mA/V et 10 mA/V)

Linear motion test:
ZLT-150/300/600 Analog linear transducers
ZLD-200/300 Digital magnetic transducers
KIT-ZLB Mechanical base for transducers
KIT-ZLR Linear-to-rotary motion converter and base (used with ZOT-2000)

Rotary motion tests:
ZRT-01/03/05/10 Analog rotary transducers
ZOT-2000 Digital optical encoder transducers
KIT-ZMS Magnetic mechanical base

Voltage tests:
ZVS-300V voltage transducers from 0 to +/-300 V or +/-1000 V

Currents tests:
CT-CLAMP-AC (100 mA/V and 10 mA/V ranges)
CT-CLAMP-AC/DC up to 30 A
ZCS 100/200/600 current transducers for up to 100/200/600 A

GENERAL

Size: L18.7" x I14.8" x H7" (L47.5cm x I37.5cm x H18cm)
Weight: < 7kg (15,43 lb)
Power supply: 100-240 VAC, 50/60 Hz, +/- 10%
Operating temperature range: 0 to 50°C (32°F to 122°F)
Storage temperature range: -20°C to 70°C (-4°F to 158°F)
Humidity: 0-95% Non Condensing
2 year warranty

COLOR OPTIONS



CBV-X

CIRCUIT BREAKER TIMING AND VIBRATION ANALYZER



What is the CBV-X ?

The CBV-X is the only instrument in the world able to perform timing, motion, vibration and dynamic resistance measurements all in a single test. The vibrations produced by circuit breakers, ON or OFF LINE, during open or close operations, contain valuable information on their condition. The CBV-X records these vibrations in order to help you identify mechanical problems.

Example of 12 contacts configuration
CBV-29:



Detected problems	Test methods	CB11		CBA-32P		CBV-X		OTM-XB	
		Online	Offline	Online	Offline	Online	Offline	Online	Offline
Contact timing	Timing test		✓		✓		✓		
Contact bounce	Timing/motion test		✓		✓		✓		
Bad damping	Motion test		✓		✓		✓		
Main contact wear	Micro-ohmmeter test		✓		✓		✓		✓
Arcing contact wear	Dynamic resistance test		✓		✓		✓		✓
Open and close coil assessment	Coil current test	✓	✓	✓	✓	✓	✓	✓	✓
Motor assessment	Current and voltage test	✓	✓	✓	✓	✓	✓	✓	✓
First trip	Measure current over 3 phases	✓		✓		✓	✓	✓	✓
Bad mechanical adjustment	Vibration test					✓	✓	✓	✓
Bad alignment	Vibration test					✓	✓	✓	✓
Bad contact timing	Vibration test					✓	✓	✓	✓



Pioneering the use of vibro-acoustics for circuit breakers !

Developed and used by Zensol for 10 years.

Highlights problems that are undetectable by traditional methods (motion,timing)

Using the vibro-acoustic method.

Performs vibro-acoustic tests while the circuit breaker is ON LINE !

Saves a substantial amount of time and money.

Optimal QUALITY, SPEED and ACCURACY of the tests

Sampling time : 5 μ s

Sampling rate : 200kHz

Ideal for tests in electrical substations

Not affected by noisy environments (up to 800 kV).

RECORDING CHARACTERISTICS

Sampling time : 5 μ s to 26 ms
Sampling rate : 38 Hz to 200 kHz
Recording time : 10 ms to 30 mins
A/D Conversion : 16 bits

DIGITAL INPUTS FOR DRY CONTACTS (3 states)

Number available: 6, 12 or 18 contacts
Contact power supply: 40 VDC

Model:

500 kV	Closed	($r < 30 \Omega$)
	Preinsertion	($30 \Omega < r < 4 \text{ k}\Omega$)
	Open	($r > 4 \text{ k}\Omega$)
800 kV	Closed	($r < 30 \Omega$)
	Preinsertion	($30 \Omega < r < 2.4 \text{ k}\Omega$)
	Open	($r > 2.4 \text{ k}\Omega$)

Each input contains 2 contacts and detects both main and resistive contacts. Each contact may also be used to measure auxiliary (a/b type) or any other dry contacts.

ANALOG CONTACT INPUTS (16 bits, 32767 states) (internal option)

A preinsertion resistance measurement module able to measure the true ohmic resistance value (0 to 7k Ω , +/- 5%) of preinsertion resistors on any type of circuit breaker during both close and open operations. The close and open connections use the same cables and inputs as the digital contacts.

Note: this module is the equivalent of an ultra-fast ohmmeter.

MULTIFUNCTION ANALOG INPUTS (16 bits)

Number available : 0, 3 or 6
Resolution : 16 bits A/D conversion
Accuracy : +/- 1 mV
Input voltage range : -10 to +10 VDC

It's possible to connect a wide range of transducers (motion, voltage, current, pressure, humidity, temperature...)

Note : 10 VDC is supplied on the Neutrik connector

ACCELEROMETER INPUTS

Number : 3 or 6
Accelerometer type : ICP
Full scale ranges : $\pm 50\text{g}$, $\pm 500\text{g}$, $\pm 1000\text{g}$
Frequency range : 1 to 20 000 Hz

COMMAND OUTPUTS/CURRENT INPUTS

Command outputs: 2 completely independent contactors (close and open, able to break up to 30A and 300V AC/DC)

Current inputs: 2 integrated and independent current transducers (in series with the two contactors)
Four software selectable current ranges: +/-20A +/-10A +/-5A +/-1A
Hall effect current transducer needs no shunt to measure current.

DIGITAL INPUTS FOR OPTICAL ENCODERS (16 bits)

Number available : 0, 3 or 6
Resolution : 8000 pulses/revolution
Type of transducer : Incremental
Automatic reset to zero before each test.

DIGITAL INPUTS FOR WET CONTACTS (2 states)

Number available : 0, 3 or 6
Response time : 5 μ s (turn-on), 40 μ s (turn-off)
Input voltage : 0-300V AC/DC
Switching voltage : 50 V DC

FIRST TRIP DETECTION INPUTS (external option)

AC current clamp which is easily connected to the analog inputs.
Typical input current : 1 to 20 A AC
Number : 0 or 3

GENERAL

Size : 17" x 16.5" x 10" (43 x 42 x 25.4 cm)
Weight : 19.84 lbs (9 kg)
Power supply : 110-240 V AC (50-60 Hz +/- 10%)
Operating temperature range: 0°C to 50°C (32°F to 122°F)
Storage temperature range: -20°C to 70°C (-4°F to 158°F)
Humidity : 0-95% non condensing.

THE SYSTEM INCLUDES

OpenZen software
Complete set of manuals
Calibration certificate and test reports
2 year warranty

ANALOG TRIGGER CAPABILITY

Works on any analog input
AC or DC signals
Rising or falling wavefronts

CBA-32P

CIRCUIT BREAKER ANALYZER



What is the CBA-32P ?

The CBA-32P is a universal analyzer with up to 24 contacts, for testing all types of circuit breakers. It can perform measurements of timing, motion and dynamic resistance of contacts, all in one single test.

Example of 24 contacts configuration CBA-32P-24C:



Detected problems	Test methods	CB11		CBA-32P		CBV-X		OTM-XB	
		Online	Offline	Online	Offline	Online	Offline	Online	Offline
Contact timing	Timing test		✓		✓		✓		
Contact bounce	Timing/motion test		✓		✓		✓		
Bad damping	Motion test		✓		✓		✓		
Main contact wear	Micro-ohmmeter test		✓		✓		✓		✓
Arcing contact wear	Dynamic resistance test		✓		✓		✓		✓
Open and close coil assessment	Coil current test	✓	✓	✓	✓	✓	✓	✓	✓
Motor assessment	Current and voltage test	✓	✓	✓	✓	✓	✓	✓	✓
First trip	Measure current over 3 phases	✓		✓		✓	✓	✓	✓
Bad mechanical adjustment	Vibration test					✓	✓	✓	✓
Bad alignment	Vibration test					✓	✓	✓	✓
Bad contact timing	Vibration test					✓	✓	✓	✓



Complete solution: performs multiple tests on many breakers at once

Up to 8 contacts/phase and 12 accessories (motion, dynamic and static resistance, first trip monitoring...)

A complete front panel !

No need for extra accessories to increase the number of inputs

Simple and secure cable connections

No loose connections such as dangerous and chaotic banana plugs.

Accurate measurement of insertion resistance even in noisy environments

Use of the RES module.

Approved by our partners, leader in their field.



RECORDING CHARACTERISTICS

Sampling time: 32 μ s to 32 ms
Sampling rate: 31.25 Hz to 31.25 kHz
Recording time: 1ms to 17 mins
A/D conversion: 12 bits

DIGITAL INPUTS FOR CONTACTS

Number available: 8, 16 or 24 contacts
Contact power supply: 40 VDC
Model:
500 kV Closed ($r < 30 \Omega$)
Preinsertion ($30 \Omega < r < 4 \text{ k}\Omega$)
Open ($r > 4 \text{ k}\Omega$)
800 kV Closed ($r < 30 \Omega$)
Preinsertion ($30 \Omega < r < 2.4 \text{ k}\Omega$)
Open ($r > 2.4 \text{ k}\Omega$)

Each input contains 2 contacts and detects both main and resistive contacts. each contact may also be used to measure auxiliary (a/b type) or any other dry contact.

ANALOG CONTACT INPUTS

(12 bits, internal option)

RES-8, RES-16, RES-24 pour 8, 16 ou 24 contacts.
A preinsertion resistance measurement module able to measure the true ohmic resistance value (0 à 7 k Ω , +/- 5%) of preinsertion resistors on any type of circuit breaker during both close and open operations. The close and open connections use the same cables and inputs as the digital contacts.
Note: this module is the equivalent of an ultra-fast ohmmeter.

MULTIFUNCTION ANALOG INPUTS (12 bits)

Number: 3 or 6
Resolution: A/D conversion 12 bits
Accuracy: +/- 2.44 mV
Input voltage range: 0 -10 V CC
It's possible to connect a wide range of transducers (motion, voltage, current, pressure, humidity, temperature...)
Note: 10 VCC is supplied Neutrik connector.

COMMAND OUTPUTS/CURRENT INPUTS

Command outputs : 2 completely independent contactors (close and open, able to break up to 30 A and 300 V AC/DC).
Current inputs : 2 integrated and independent current transducers

(in series with the two contactors). Eight software selectable current ranges ; +/-20A +/- 10A +/- 5A +/- 1A, 0-1A 0-5A 0-10A 0-20A
Hall effect current transducer needs no shunt to measure current.

DIGITAL INPUTS FOR OPTICAL ENCODERS (16 bits)

Number available : 3 or 6
Resolution: 8000 pulses/revolution
Type of transducer: Incremental
Automatic reset to zero before each.

DIGITAL INPUTS FOR WET CONTACTS (2 states) (internal or external option)

Number available: 0, 3 or 6
Response time: 5 μ s turn-on, 40 μ s turn off
Input voltage: 0-300 AC/DC
Switching voltage: 50 V CC

FIRST TRIP DETECTION INPUTS (External option)

AC current clamp which is easily connected to the analog inputs.
Typical input current: 1 to 20 A AC
Number: 0 or 3

GENERAL

3 available case sizes: 13" x 13.5" x 7" (33 x 35 x 18 cm)
17" x 16.5" x 10" (43 x 42 x 25.4 cm)
18" x 19" x 8.9" (46 x 48 x 22.6 cm)

Weight: CBA-32P 8C: 27.5 lb (12.5 kg)
CBA-32P 16C: 34.2 lb (15.5 kg)
CBA-32P 24C: 38 lb (17 kg)

Power supply: 110-120 VAC or 220-240 VAC 50/60 Hz
Operating temperature range: 0°C to 50°C (32°F to 122°F)
Storage temperature range: -20°C to 70°C (-4°F to 158°F)
Humidity: 0 to 95% non condensing

THE SYSTEM INCLUDES

- CbaWin© software
- Complete set of manuals
- Calibration certificate and test reports
- 2 year warranty

OTM-XB

STANDALONE SPORADIC EVENT RECORDER
FOR CIRCUIT BREAKERS



What is the OTM-XB ?

The OTM-XB is the only standalone recorder to use the vibroacoustic method that detects intermittent and sporadic operational faults on working circuit breakers.



Detected problems	Test methods	CB11		CBA-32P		CBV-X		OTM-XB	
		Online	Offline	Online	Offline	Online	Offline	Online	Offline
Contact timing	Timing test		✓		✓		✓		
Contact bounce	Timing/Motion test		✓		✓		✓		
Bad damping	Motion test		✓		✓		✓		
Main contact wear	Micro-ohmmeter test		✓		✓		✓		✓
Arcing contact wear	Dynamic resistance test		✓		✓		✓		✓
Open and close coil assessment	Coil current test	✓	✓	✓	✓	✓	✓	✓	✓
Motor assessment	Current and voltage test	✓	✓	✓	✓	✓	✓	✓	✓
First trip	Measure current over 3 phases	✓		✓		✓	✓	✓	✓
Bad mechanical adjustment	Vibration test					✓	✓	✓	✓
Bad alignment	Vibration test					✓	✓	✓	✓
Bad contact timing	Vibration test					✓	✓	✓	✓



The only standalone recorder to use the vibro-acoustic method on breakers

Listen to the heart of your circuit breaker like a doctor with a stethoscope.

Detect hidden problems that are undetectable by traditional methods (motion, timing)

Using vibro-acoustics.

Records vibro-acoustics tests while the breaker is ON LINE !

Your new money and time-saving tool !

Automatic recording of operations.

Once installed, it is completely autonomous.

Remote testing



RECORDING CHARACTERISTICS

Sampling time: 10 μ s to 26ms
Sampling rate: 38Hz to 100kHz
Recording time: 10ms to 30 min
A/D conversion: 16 bits
Local storage capacity: 64Go

ACCELEROMETER INPUTS

Number: 3
Accelerometer type: ICP
Resolution: 16 bits A/D conversion
Full scale ranges: +/-50g, +/-500g, +/-1000g
Frequency range: 1 Hz to 200 kHz
Signal to noise ratio: better than 80DB

MULTIFUNCTION ANALOG INPUTS (16 bits)

Number: 5
Resolution: 16 Bits A/D conversion
Accuracy: +/- 0.3 mV
Input voltage range: +/- 10VAC (compatible with any transducers)

COMMAND OUTPUTS

Command outputs: 3
Type: solid state, opto-isolated
Voltage range: 2-200VDC
Max. load current: 3.5 A
Turn-on time: 75 μ s maximum
Turn-off time: 750 μ s maximum
Independently controlled turn-on and turn-off timing

REMOTE ACCESS

- Continuous and complete control of data, test plans, software
- Ability to perform tests remotely
- Easy access to recorded data via your network
- Completely automated and scheduled tasks

ETHERNET PORT

Bandwidth: 10/100 Mo/s
Remote control and retrieval of data

USB PORT

Bandwidth: 12/480 Mo/s

OPTIONAL ACCESSORIES

Accelerometers
Current clamps
Local memory expansion
USB memory stick
USB bluetooth module
USB Wi-Fi module
10-32 to BNC cables (3 feet)
BNC-to-BNC extensions (25 and 50 feet)
Cable reel with 4 extensions of 50 feet
Accelerometer mounting bases
Glue
Waterproof case

GENERAL CHARACTERISTICS

Size: 19" x 3.5" x 18" (48.2 x 8.8 x 45.7 cm)
Weight: 13.2 lbs (6 kg)

Power supply: 100-240 VAC 50/60 Hz +/- 10%
Operating temperature range: 0 to 50°C (32°F à 122°F)
Storage temperature range: -20°C to 70°C (-4°F à 158°F)
Humidity: 0-95% non condensing

ANALOG TRIGGER CAPABILITY

Works on any analog input
AC or DC signals
Rising or falling wavefronts
Works in noisy environments

SPECIAL PROTECTION



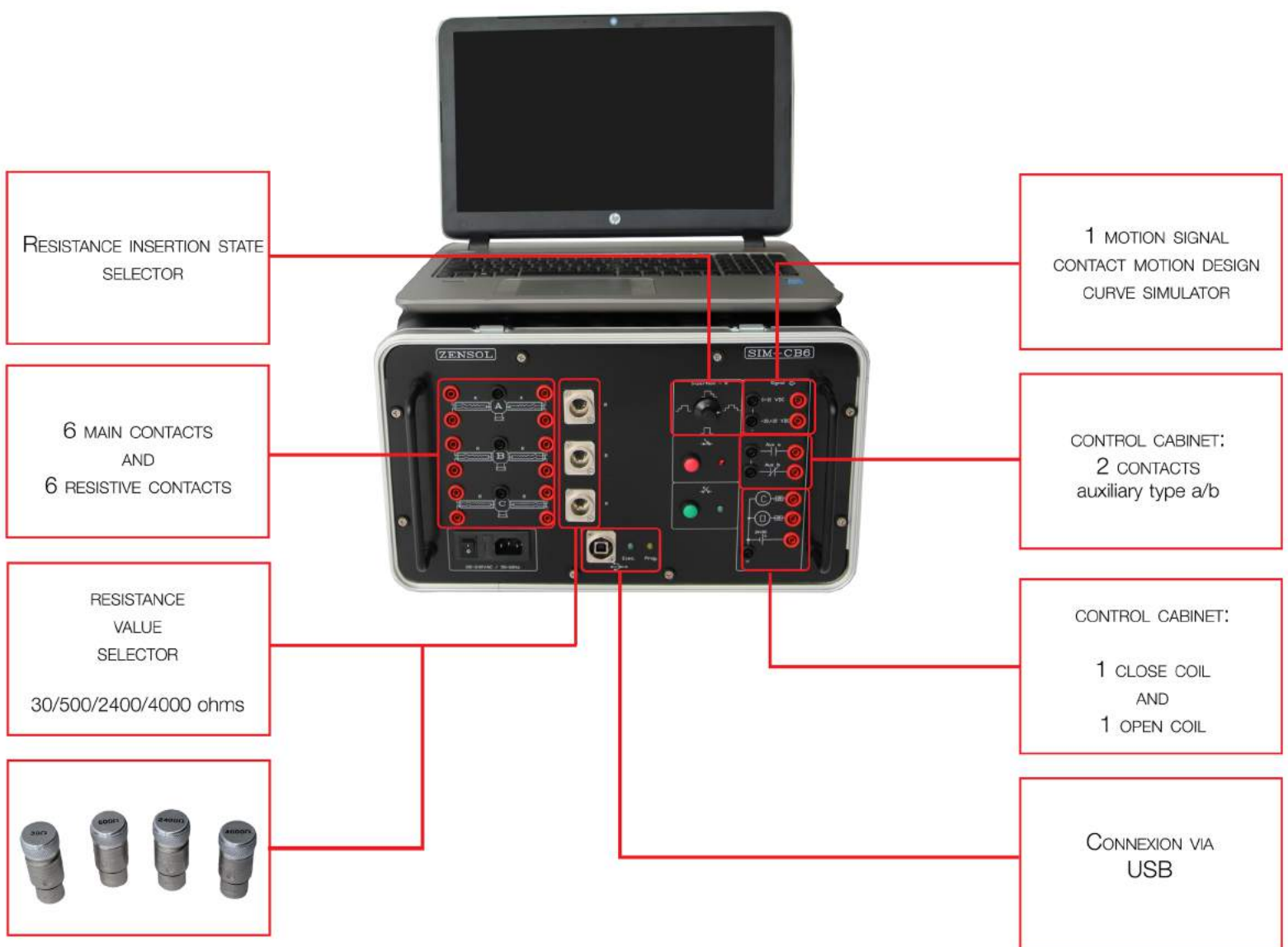
SIM-CB6

CIRCUIT BREAKER AND
CONTROL CABINET SIMULATOR



What is the Sim-CB6?

The SIM-CB6 lets you simulate any type of circuit breaker (SF6, Air Blast, Oil, etc.) up to 6 contacts (2 contacts per phase), with or without resistive contacts, the mechanism displacement, as well as the close and open coils of the control cabinet.





Training tool that makes your teams **EFFICIENT** in the field.

SIMULATES either a working or faulty circuit breaker.

UNLIMITED choice of contact insertion resistors.

Simulates a breaker's motion signal during open, close and even close-open operations.

Quick **RETURN ON INVESTMENT** thanks to the instrument's very competitive pricing.

SIM-CB6

www.zensol.com www.zensol.net

CIRCUIT BREAKER AND CONTROL CABINET SIMULATOR:

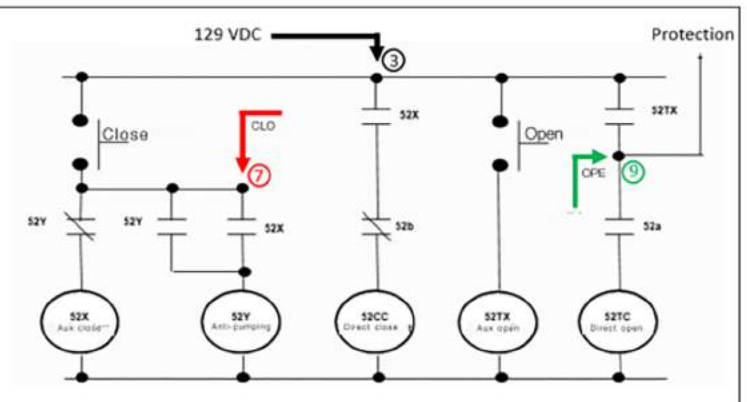
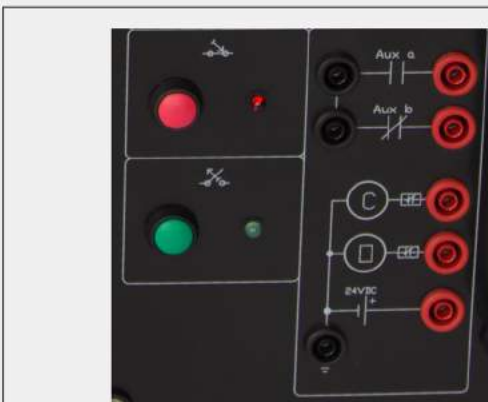
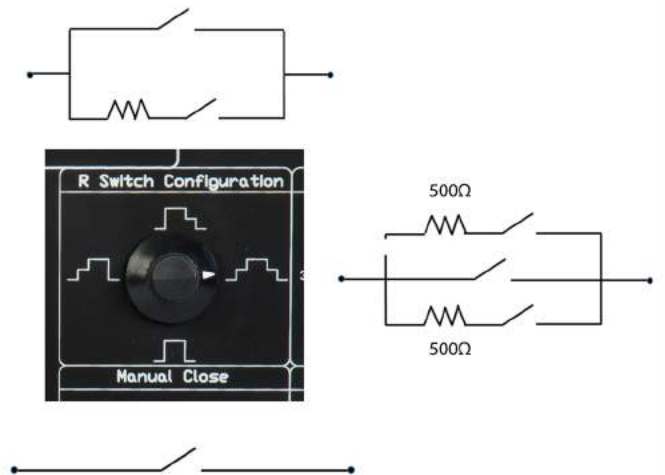
- Up to 6 contacts (2 contacts per phase)
- Auxiliary 52a and 52b contacts
- Manual selection of insertion resistance : 30, 500, 2400 and 4000 Ohms
- Manual commands : close and open
- Visual contact state display
- Simulates contact displacement

GENERAL

Size: 17"x16.5"x10" (43x42x25.4 cm)
 Power supply: 100-240 VAC 50/60 Hz
 Operating temperature range: 0°C to 50°C (32°F to 122°F)
 Storage temperature range: -20°C to 70°C (-4°F to 158°F)
 Humidity: 0-95% non-condensing
 Languages: English and French

THE SYSTEM INCLUDES

SimWin software
 2 year warranty



KIT MO-SD

STATIC AND DYNAMIC MICRO-OHMMETER



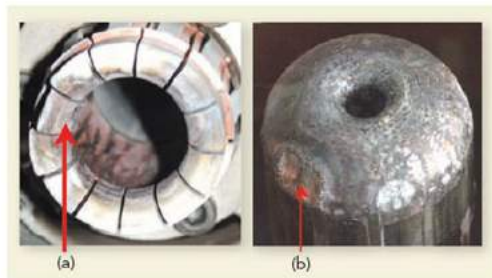
What is the Kit MO-SD?

Dynamic Contact Resistance Measurement (DCRM) is a widely recognized method to determine the condition of a breaker's main and arcing contacts, without opening it. The DCRM test (KIT MO-SD) is the ideal tool to measure contact resistance as a function of time.

For circuit breakers, this resistance may be measured either at the rated speed or at slow speed, during an open operation.

We recommend to run the test at a slow speed, if a problem is detected, before opening the breaker.

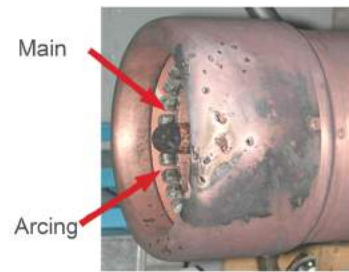
Bad contact alignment



Fixed

Moving

Arc pitting on fixed contacts



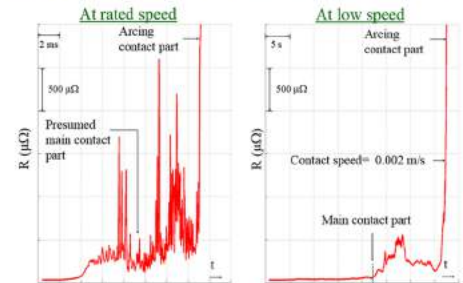
Moving

Detected problems	Static micro-ohmmeter	Dynamic micro-ohmmeter
Arcing contact wear		✓
Arcing contact length		✓
Main contact wear	✓	✓
Bad contact alignment		✓
Bad contact adjustment		✓
Hot spots (high joint resistance)	✓	✓
Contact fingers		✓
Contact surfaces		✓
Blasting nozzles		✓
Crossing joints		✓

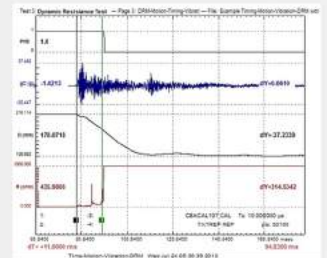


Slow open test

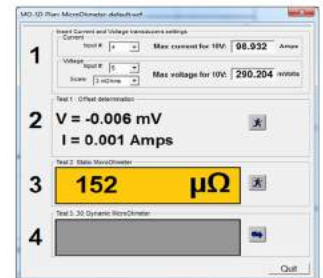
DRM test on a capacitive SF6 breaker of 120 kV rating.



Simple and unique correlation



Clear and simple display of results



Stable and continuous DC power supply

Technology	Advantages	Disadvantages
Classic DC current source supplied with the KIT MO-SD	Very long recording time (from 10 seconds to several hours) for a perfect measurement of dynamic resistance. Simpler interpretation	
Capacitor discharge current source		60 second charging time between tests. Unstable current source. Not possible to perform slow speed tests with a short-duration current source (30-50 ms)
Battery-based current source		Risk of explosion due to short circuit when the breaker closes.

Modular design

Modules are separately usable to inject and measure high currents, as well as measure very low voltages.



Technical specifications

KIT MO-SD

www.zensol.com www.zensol.net

TECHNICAL SPECIFICATIONS

- Recording time: 10ms to 17min
- Measurement range: 5 micro-Ohms to 1 Ohm
- Resolution 0.1 Ohm
- Accuracy $\pm 0.5\%$
- Utilizable : CBA, CBV, OTM-X or CB11

ZVS-100/200 VOLTAGE MEASUREMENT MODULE:

- Input voltage 0-300mV or 0-20mV
- Output voltage: 0-10V
- Accuracy ($\pm 0.2\%$)
- Low temperature drift
- High speed transfert
- Powered by Zensol instrumentsI (CBA, CBV, CB11)
- Size: 5.5 x 3.15 x 1.77 inches (140x80x45mm)

ZCS-100/200/600 CURRENT MEASUREMENT MODULE:

- Measurement range: 0-100A
- Galvanically isolated
- Accuracy ($\pm 0.2\%$)
- Linear ($< 0.1\%$)
- Low temperature drift
- High speed transfert
- Powered by Zensol instruments (CBA, CBV, CB9)
- Size: 5.9 x 3.15 x 1.77 inches (150x80x45mm)

PS-100 Manual DC current source

- Adjustable current output: 40-100A
- Adjustable voltage output: 2-5.5 VDC
- Universal power input: 90-264 VAC, 47-63Hz
- Operating temperature: -30/+70Deg°C
- Accuracy: 0.5%
- Quick and simple cable connections
- Size: 12.6x6.7x3.46 inches (320x170x88mm)
- Weight: 8.8 lb (4 Kg)

PS-100-2 Manual/programmable DC current source

- Adjustable current output: 0-100 A
- Adjustable voltage output: 0-8 VDC
- Standard digital interfaces – USB/RS232/485
- Power input: 110-240 VAC, 47–63 Hz
- Operating temperature: 0-50 DegC
- Accuracy: 0.5%
- Size: 18.9 x 8.4 x 1.7 inches (479.2x214.2x43.6mm)
- Weight: 9.92 lb (4.5Kg)

PS-200 Manual/programmable DC current source

- Adjustable current output: 0-200A DC
- Adjustable voltage output: 0-8 V
- Standard digital interfaces– USB/RS232/485
- Isolated analog interface and Ethernet LXI
- Universal power input: 85–265 Vac, 47–63 Hz.
- Operating temperature: 0-50 DegC
- Accuracy: 0.5%
- Size: 16.8 x 1.7 x 19.0 inches (429 x 43.6 x 483 mm)
- Weight: 22 lbs (10 kg)

Conducting cables:

- AWG 4/0
- Carolprene® 105°C, black
- Operating temperature: -50°C à +105°C
- 600 Volt cable
- Resists water, sunlight, oil, acids, alkalis, heat, flame, moisture and chemical solutions
- Exceeds MSHA flame resistance standards

Carrying cases:

- Z-VAL-4 for PS-100
- Z-VAL-6 for PS-200



35 or 50 feet
10.66 m or 15.24 m
Ref: CAB-PS-B-35/50
Ref: CAB-PS-R-35/50



Ref: EXT-CONT-N-10/25



Ref: CONT-10-M



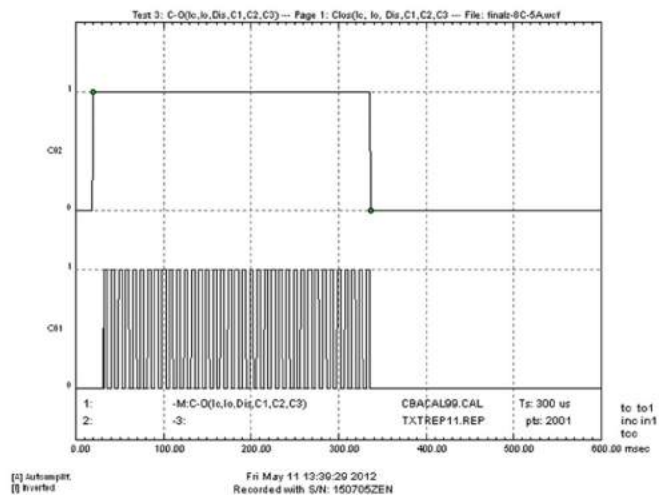
Carrying case
for easy transport

AC/DC CONTACTS

WET CONTACT ZVD-AC-DC-300-CONTACT



DESIGNED TO DETECT AC/DC VOLTAGE UP TO 300 VOLTS



FIRST TRIP MONITORING

RECORDING OF FIRST TRIP OPERATION Z-FT



REFERENCE : Z-FT-CBA

AC current clamp for first trip recording.

2 scales : 10mV/A and 100mV/A

Neutrik connector for 0-10V analog inputs of the CBA-32P.

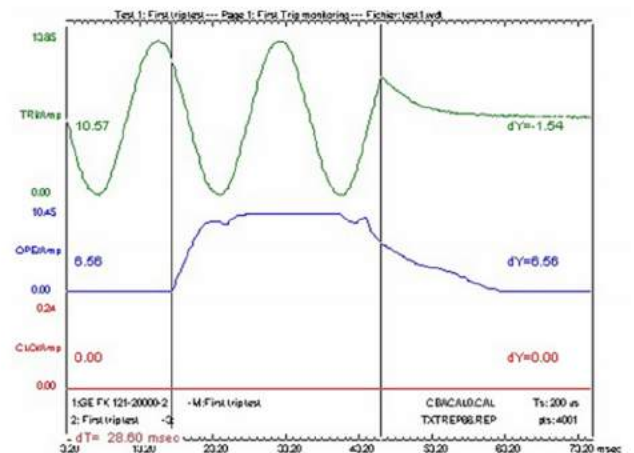
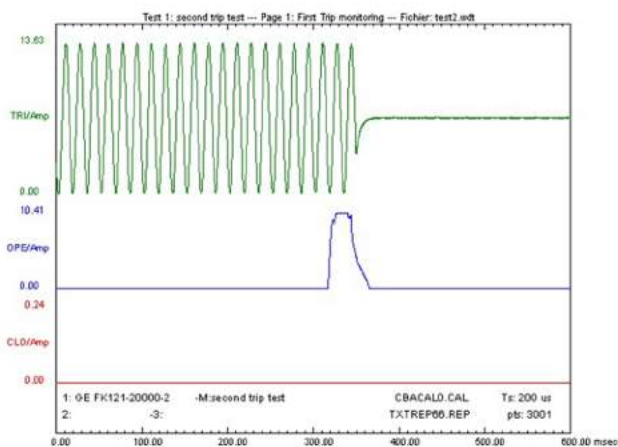
REFERENCE : Z-FT-CBV

AC current clamp for first trip recording.

2 scales : 10mV/A and 100mV/A.

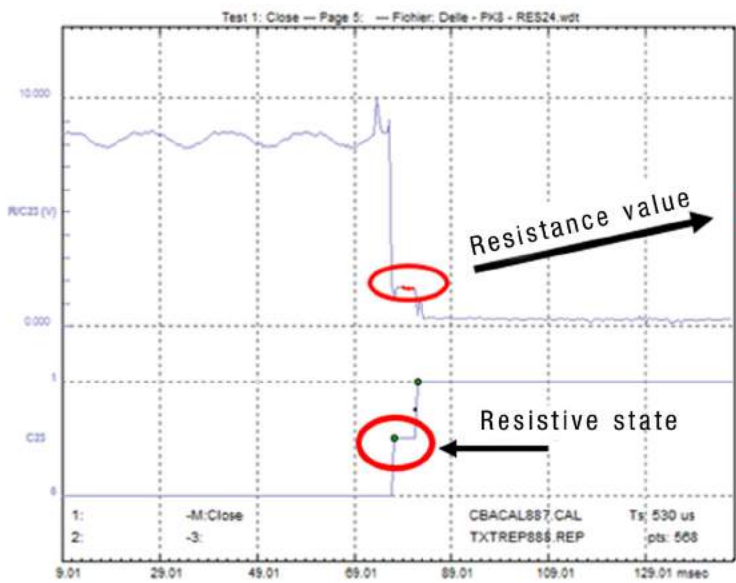
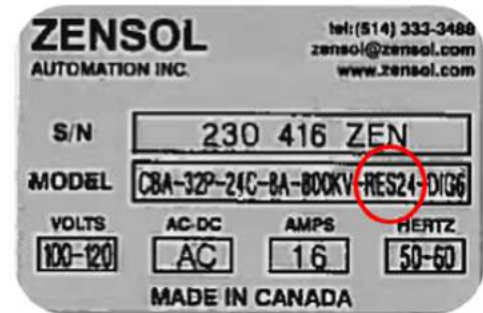
Neutrik connector for +/- 10V analog inputs of the CB11 and CBV-X.

CONVERTS CURRENT TO VOLTAGE

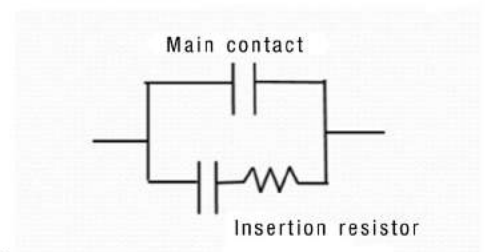


RES 8-16-24

This module will let you measure the ohmic resistance value of pre-insertion contacts in very noisy environments (up to 800 kV).



Circuit breaker with insertion contact



Breaker resistance value in Ohms

[A] Autoamp.
[I] Inverse
[R] Resist

Tue Apr 21 10:54:48 2009
Enregistré avec N/S: 230108ZEN



DUAL GROUNDING

Dual Grounding is the remote solution for safely lifting the ground connection of a circuit breaker.



Z-DUAL-GR module



Front panel



WHY ?

- Simplifies tests
- Safety of personnel

WHEN ?

- For all tests (timing, contact tests, motion tests...)

How ?

- By connecting in series with the breaker's ground connections to isolate the circuit;
- By operating remotely

KIT ZMS

MAGNETIC BASE: KIT-ZMS



Lets you attach any type of transducer (resistive or optical) to any type of circuit breaker.



With a resistive displacement transducer
Ref : ZRT-01/03/05/10



With an optical encoder
Ref : ZOT-2000



MOUNTING BASE FOR LINEAR TRANSDUCERS KIT-ZLB



For measuring linear motion, use the ZLT or ZLD linear displacement



Ref : ZLT-150/225/300/600 and ZL-200/300

KIT ZLR

LINEAR TO ROTARY MOTION CONVERTER FOR POTENTIOMETERS AND ENCODERS



Converts a linear motion into a rotary one



With a resistive displacement transducer
Ref : ZRT-01/03/05/10



With an optical encoder
Ref: ZOT-2000

TRANSDUCCERS

LINEAR RESISTIVE DISPLACEMENT TRANSDUCER

Ref : ZLT-150/300/600

150 to 600mm, with connector for analog inputs on Zensol instruments (CBA, CBV, CB11), to measure linear contact motion.



DIGITAL DISPLACEMENT TRANSDUCER

Ref : ZLD-200/300

0 to 200 mm, used with optical/magnetic digital inputs. Powered by the CBA/CBV/CB digital input.



ROTARY RESISTIVE DISPLACEMENT TRANSDUCER

Ref : ZRT-01/03/05/10

1 to 10 revolutions, with coupling adaptor and a connector for analog inputs on Zensol instruments (CBA, CBV, CB11), to measure rotary contact motion.



ROTARY OPTICAL ENCODER TYPE DISPLACEMENT TRANSDUCER

Ref : ZOT-2000

2000 pulses per revolution, with no limit to number of revolutions. Sturdy, it is protected so it may be used efficiently in noisy, humid or greasy environments.



DC VOLTAGE TRANSDUCER

Ref : ZVS-100/200

Measures DC voltages from : 0,4 to 200 mV
Used with kit MO-SD-100/200.
Measures resistance values of $2\mu\Omega$ (ZVS-200) or $200\mu\Omega$ (ZVS-100).



AC/DC VOLTAGE DETECTOR

Ref : ZVS-AC-DC-300-contact/analog

Detects the presence of a continuous voltage and circuit breaker faults.
2 models: for analog or contact inputs.



TRANSDUCCERS

VOLTAGE TRANSDUCER

Ref : ZVS-300

Measures from 0 to $\pm 300V$ or $\pm 1000V$. Powered by the CBA/CBV/CB11.



CURRENT TRANSDUCERS

Ref : ZCS - 50/100/200/600

Measures up to 50, 100, 200 ou 600 Amps AC, DC or transients.. Designed for Zensol instruments (CBA, CBV, CB11).



AC 20A/200A CURRENT CLAMP

Ref : CT-CLAMP-AC

Used to measure AC current in electrical equipment
2 ranges : 20A or 200A.
Connects to the analog inputs of Zensol instruments.



AC /DC CURRENT CLAMP

Ref : CT-CLAMP-AC/DC

Used to measure AC currents of up to 30A in electrical equipment.
Connects to the analog inputs of Zensol instruments.



PRESSURE TRANSDUCER

Ref : ZPS - 5000

Just right for your pressure measurement needs.
High accuracy even in noisy environments.
High level of protection.



TEMPERATURE TRANSDUCER

Ref : ZTS - RTD

Converts all types of temperature, probes and thermocouples. Used in industrial environments and able to measure temperatures of $-200^{\circ}C$ to $+850^{\circ}C$.



ACCELEROMETERS

ACCELEROMETERS 10g

Ref : ACC-10g

For circuit breakers.
Measurement range :
500mV/g, 10g



ACCELEROMETERS 50g

Ref : ACC-50g

For circuit breakers.
Measurement range :
100mV/g, 50g



ACCELEROMETERS 500g

Ref : ACC-500g

For circuit breakers.
Measurement range :
10mV/g, 500g



ACCELEROMETERS 1000g

Ref : ACC-1000g

For circuit breakers.
Measurement range :
5mV/g, 1000g



ACCELEROMETER MOUNTING BASE

Ref : TAP-BASE

Mounting base for
accelerometers.



CABLES

ARCTIC CABLES FOR CONTACTS 15

Ref : CONT-WP-EC-15-B

Applicable models are the contact cables and extensions.

For all Arctic and waterproof cables

From -50°C (-58°F) to 80°C (176°F).



STANDARD CABLES FOR CONTACTS 10

Ref : CONT-N-10-B

For CBA and CBV
Cable for 2 breaker contacts.
Battery-type clamps, 10 feet.

Ref: CONT-N-10-B-1C or
CONT-WP-EC-10-B-1C

For CB-11
Cable for 1 breaker contact.
Battery-type clamps, 10 feet.



SPECIAL CABLE FOR CHINA

Ref : CONT-WP-EC-50-B-1C

Single contact cable, 50 feet.
(15,24m)



CABLE FOR OIL CIRCUIT BREAKER

Ref : C-OCB

Contact cable for oil circuit
breakers. (3 contact, 1 common)



CABLE EXTENSION

ARCTIC CONTACT/DISPLACEMENT EXTENSION

Ref : EXT-CONT-WP-EC
25/50/100/150

For digital contact and analog
inputs.

Lengths : 25 feet (7.62m)
50 feet (15.24m)
100 feet (30.48m)
150 feet (45,72m)



CABLE EXTENSION

STANDARD CONTACT/DISPLACEMENT EXTENSION

Ref : EXT-CONT-N-10/25/50/100

For digital contact and analog
inputs.

Lengths : 10 feet (3.05m)
25 feet (7.62m)
50 feet (15.24m)
100 feet (30.48m)



CABLES

COMMAND CABLES 25/50'

Ref : COM-N-10/35

4 conductors with alligator-type clips.

Length: 10 feet (3.05m)
35 feet (10.67m).



COMMAND CABLE EXTENSIONS

Ref : EXT-COM-N-25

Command cable extension.

Length: 25 feet (7,62m).



GROUND CABLE

Ref : GND-25

Grounding cable.

Length: 25 feet (7.62m).



52A/B CABLE 10'

Ref : 52a/52b-10

For auxiliary contact tests.

Length: 10 feet (3.05m).



ANALOG CABLE

Ref : DISP-N-10

Small alligator-type clips cable.
To connect any transducer of
+/-10V to analog inputs

Size: 10 feet (3.05m).



OPTICAL ENCODER EXTENSION CABLE

Ref : EXT-ENC-N-25/50

For digital optical encoder inputs.

Size: 25 feet (7.62m)
50 feet (15.24m).



CABLES

WET CONTACT CB11

Ref : WET-CAB-CB11

Wet contact cable for CB11

Length: 10 feet (3.05m).



WET CONTACT CBV-X

Ref : WET-CAB-CBV

Wet contact cable for CBV.

Length: 25 feet (7.62m)



ACCELEROMETER CABLE

Ref : C-BNC-03

With BNC and 10-32 connectors.

Length: 3 feet



ACCELEROMETER EXTENSION CABLE

Ref : C-BNC-BNC-25/-50

Male BNC to male BNC cable with female connector adaptor.

Length: 25 feet (7.62m)
50 feet (15.24m).



CABLES

FIBER USB

Ref : FIB-USB

High speed USB fiber optic module with USB cable.



POWER CABLE

Ref : CAB-ALIM Power cable for systems, compatible with North American power outlets.

Ref : CAB-ALIM-CH. Compatible with Chinese power outlets.

Ref : CAB-ALIM-EU. Compatible with European power outlets.



FIBER OPTIC CABLE

Ref : FIB-10/FIB-50

Fiber optic cable with ST-type connectors.

Length : 10 feet (3.05m)
50 feet (15.24m).



CABLE REEL

Ref : BNC-REEL-4X50

Reel with four 50 feet BNC extensions for the CBV.



CABLE USB

Ref : USB-CAB

USB cable to connect your system to your computer.



CABLE REEL

Ref : R300S

To easily roll and unroll your cables. Three settings : Free Spool, Soft Brake, Full Lock. Weight: 4,3 kg. Length: 36x34x25 cm.



CASES AND BAGS

REF : Z-VAL-7



Wheeled rigid carrying case for system cables and accessories, as well as a protective case for OTM-X.
Length: 22"x17"x10" (56x43.2x25.4 cm)

REF : Z-VAL-3



Wheeled rigid carrying case for the system and its cables and accessories (exceptions : CBA-32P-16C and CBA-32P-24C)
Length: 35"x14"x36" (88.9x35.6x25.4 cm)

REF : Z-VAL-3 ET Z-VAL-7



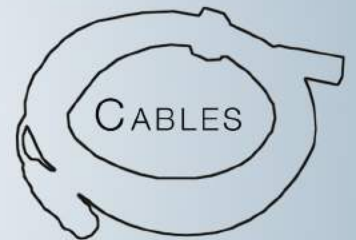
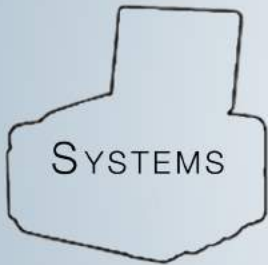
A sturdy, waterproof and easy to carry case, it protects your products from impacts and the elements.

REF : Z-BAG



Bag for carrying a systems cables and accessories.

CONTACT US DIRECTLY!
FOR ANY SPECIAL REQUESTS!



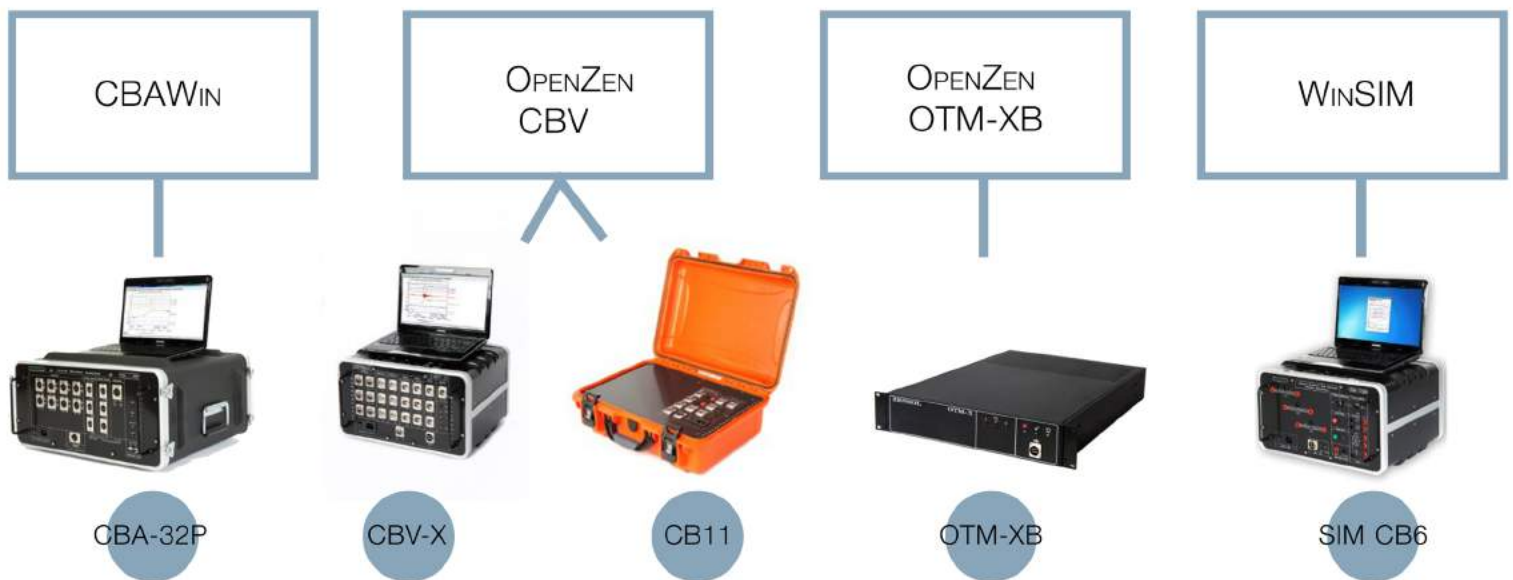
SOFTWARE

FOR CIRCUIT BREAKER ANALYZERS



OPENZEN AND CBAWIN SOFTWARE

Our recording and analysis software drives each of our instruments.
Circuit breaker diagnostics are performed from
a single graphical interface.



SOFTWARE CHARACTERISTICS

- Assists the decision-making process thanks to interpretation methods based on real-world cases;
- Applies to any type of circuit breaker (ABB, Schneider, GE, SIEMENS, etc.);
- Quick and automated test sequences;
- Minimal and simple operator input.

- Able to compare tests;
- Includes all the necessary tools for analyzing tests in the field or in the lab;
- Used to process, calculate and interpret test results, with online help needed by circuit breaker maintenance professionals;
- Free updates.



CBAWin and OpenZen assist the operator in all tests.

Once the cables are connected to the breaker and the instrument is connected to the PC.

Even an new user can perform all tests right away.

By simply choosing the type of circuit breaker in our huge test plan library.

Results analysis is simpler thanks to powerful graphical analysis tools (X and Y zoom).

Access to values in microseconds and amplitude.

Basic and advanced mathematical functions

For calculating closing and opening times, displacement, speed, etc.

Instant signal export to Word and Excel, with professional reports.

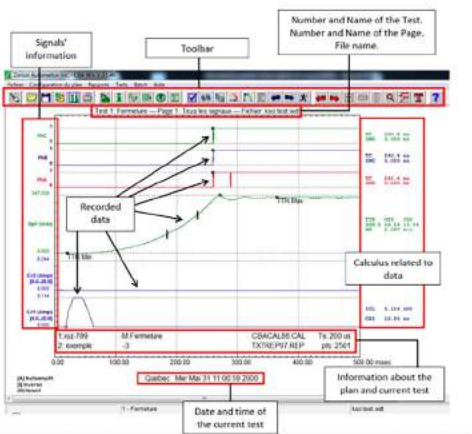


ZENSOL OFFERS TRAINING IN THE USE OF OUR CIRCUIT BREAKER DIAGNOSTIC SOFTWARE !

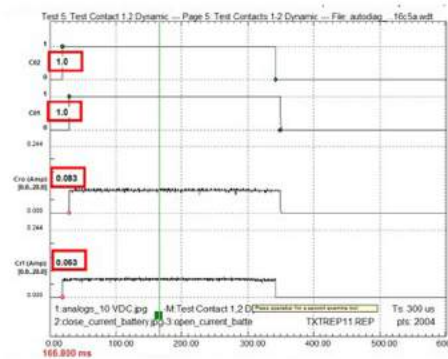
Various PDF guides

Basic training

Advanced training



Files Manipulation	Test configuration	In the field	Analysis
Assistant mode	Test configuration	Check setup	Previous page
Open plan	Plan information	Test link	Next page
Save data	Analog inputs	Test cables/Breaker status	Examine
Export	Contacts	Close Order	Horizontal scale
EVA export	Optical encoders	Open Order	Vertical scale
Print displayed report	Processing	Connections / Infos	Zoom
		Previous test	Graphic report design
		Next test	View tabular report
		Execute test	Help
		Static/Dynamic Micro-Ohm-meter	





SEMINARS

ZENSOL is not just a manufacturer of instruments. our team regularly sets up technical seminars in the field of high-voltage substations, on OLTCs, reclosers and especially circuit breakers.

Example 1

SUBJECT PRESENTED

- The importance of synchronization between breaking chambers on a high-voltage circuit breaker.
 - Dynamic contact resistance measurements on high-voltage circuit breakers.
 - Vibro-acoustic diagnostics on high-voltage circuit breakers.
- Example of a maintenance program.

WHAT YOU WILL LEARN

- Complete and detailed understanding of the importance of planned maintenance.
- Usefulness of standards and of our approved and validated instruments that conform to these standards.

Example 2

SUBJECT PRESENTED

- Usefulness of standards and of our approved and validated instruments that conform to these standards.
- Displacement transducers and their installation on circuit breakers, with case studies on GL/HGF (Areva), HPL (ABB) and KSO (SE).
- Vibration transducers (generating station case).
- Current and voltage transducers (case studies).
- First trip measurements.

WHAT YOU WILL LEARN

- Measurement methods of Zensol circuit breakers analyzers.
- Using OpenZen software.
- How to install displacement transducers on high-voltage circuit breakers.
- Using vibration transducers.

ANALYSIS AND TESTING SERVICES

OUR EXPERIENCE AT YOUR SERVICE !

Our diagnostic team has performed a multitude of tests on every type of circuit breaker around the world !

We have thus acquired some unique experience in the field of circuit breaker diagnostics.

We also offer data analysis and interpretation services as well as training, and free test assistance services.



CONTACT US !

SHARING KNOWLEDGE

To know more about circuit breaker diagnostics, visit our web site, you will find many articles.

General

General article about circuit breaker testing

Time breaker testing

Importance of breaker timing and testings

Motion testing

Ensures good contact motion in the circuit breaker

Dynamic resistance measurement testing

Measures the dynamic resistance of breaker contacts

First trip online test

Capture the first trip of your circuit breaker

Vibration testing

The vibration technology applied to circuit breaker testing

Share your knowledge about circuit breakers with us. Submit an article to us for eventual publication on our web site.

www.zensol.com/en/sharing-knowledge



HOURS Monday to Friday
From 8:30am to 5pm



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