DATE: 21/02/2023   **DOC.SIE10166**   **REV. 13**

CIRCUIT BREAKER ANALYZER AND MICROOHMMETER MOD. CBA1000

REVISIONS			SUMMARY	VISA
N	PAGE	DATE		
1	All	22/07/2005	Preliminary issue	Lodi.
2	All	01/06/2006	Issued	Lodi
3	13	03/07/2006	Added the description of the DC loss test option	Lodi
4	15,16	13/04/2007	BSG option detailed	Puricelli
5	15, 16, 17	1/10/2007	Completed the BSG1000 option description	Lodi
6	17	7/11/2007	BSG1000 option description revised	Puricelli
7	15	12/12/2007	Auxiliary cable length corrected to 6 m	Lodi
8	13	30/09/2008	Added the 70 V MTC option and the long connection cables option	Lodi
9	26-	15/03/2009	Modified to FW revision 2.19	Lodi
10	23	18/1/2011	Improved the clamp specification; added pictures	Lodi
11	8	25/07/2016	Modified Timing Resolution and Accuracy	Gastaldelli
12	18 , 19, 20	10/03/2021	BSG1000 option removed	Puricelli
13	4,6,7	21/02/2023	Minor updates	Puricelli

APPLICABLE STANDARDS

The test set conforms to the EEC directives regarding Electromagnetic Compatibility and Low Voltage instruments.

A) Electromagnetic Compatibility:
Directive no. 2004/108/EC. Applicable Standard : EN61326-1 + A1 + A2.
EMISSION
- EN 61000-3-2 + A2: Harmonic content of power supply. Acceptable limits: basic.
- EN 61000-3-3 + A1: Limitation of voltage fluctuations and flicker. Acceptable limits: basic.
- CISPR16 (EN 55011 class A): Limits and measurement methods of radio-electric disturbances for industrial, medical and scientific instruments at radio-electric frequencies.
Acceptable limits for conducted emission:
. 0.15-0.5 MHz: 79 dB pk; 66 dB avg.
. 0.5-5 MHz: 73 dB pk; 60 dB avg.
. 5-30 MHz: 73 dB pk; 60 dB avg.
Acceptable limits for radiated emission:
. 30-230 MHz: 40 dB (30 m)
. 230-1000 MHz: 47 dB (30 m)
IMMUNITY
- EN 61000-4-2 + A1 + A2: Immunity tests for ESD. Test values: 8 kV in air; 4 kV in contact.
- EN 61000-4-3 + A1; Immunity tests for radio frequency interference. Test values (f= 900 ± 5 MHz): field 10 V/m, modulated AM 80%; 1 kHz
- EN 61000-4-4; Immunity tests for high speed transients (burst). Test values: 2 kV peak; 5/50 ns.
- EN 61000-4-5 + A1; Immunity tests for surge. Test values: 1 kV peak differential mode; 2 kV peak common mode; 1.2/50 us.
- EN 61000-4-6 + A1: immunity to low-voltage sinusoidal waveform. Test values: 0.15-80 MHz, 10 Vrms, 80% AM 1 kHz.
- EN 61000-4-8 + A1: Immunity tests for low frequency magnetic fields. Test values: 30 Arms/m.
- EN 61000-4-11: Immunity test for power supply drops. Test value: 1 cycle; 100% drop.

B) Low Voltage Directive
- - Directive n. 2006/95/EC. Applicable standard: EN 61010-1. In particular, for a pollution degree 2:
- Isolation resistance: > 2 MOhm.
- Earth resistance :< 0.1 Ohm.
- Dielectric rigidity 1.4 kV AC, 1 minute.
- Inputs/outputs protection: IP 2X - EN60529.
- Operating temperature:-10°C to 55 °C; storage: - 20 °C to + 70 °C.
- Relative humidity : 5 - 95%, without condensing.
- Vibration: IEC 68-2-6 (20 m/s^2 at 10 – 150 Hz);
- Shock: IEC 68-2-27 (15 g; 11 ms; half-sine).
- Altitude: less than 2000 m.
- Dispersion current: less than 5 mA.

1 *INTRODUCTION*

The circuit breaker analyzer and microOhmmeter model CBA1000 is a two-in-one test set.

When used as a circuit breaker analyzer, it allows the off-line testing of the characteristics of all modern MV, HV and EHV circuit breakers (commissioning or maintenance) . The test set measures CB operation times as they are defined in the IEC standard 62271-100; in particular:
. Opening time: see 3.7.133;
. Closing time: see 3.7.136;
. O-C time: see 3.7.139;
. C-O time: see 3.7.143;
. Minimum trip duration: see 3.7.146;
. Minimum close duration: see 3.7.147.

When used as a microOhmmeter, it allows measuring the contact resistance of the circuit breaker contact, or also of joints or other circuit parts. It allows also to perform the dynamic test of the contact resistance, that is to record and display how does the contact resistance change while it is closing: this allows detecting hidden defects, that are otherwise impossible to be diagnosed.

The instrument performs the following features:
. Test set control: via keypad plus selection knob plus dedicated keys, and a large transflective LCD display (320 x 240 pixels; view area 122 x 92 mm) or via PC with TDMS SW.
. Optional internal thermal printer 58 mm wide or external thermal printer 112 mm wide.
. Huge recording capability: 128 Mb (typically 250 results).
. USB and RS232 interface for data communication with the PC.
. Two driving coil circuits (O+C); 4 opt. The coil current is independently measured on all outputs, with three current ranges.
. Three sets of two main contact sensing circuits (two chambers tests). Test of the main contact and of the pre-insertion resistor.
. Four digital event input circuits.
. For the main and event inputs, measurement of delays with respect to coil currents or other references.
. The Open or Closed state of main and event inputs is displayed by a light: thanks to these lights, the status of the circuit breaker is continuously monitored.
. Capability of controlling up to four test sets, for tests of CB's with up to 8 chambers per phase.
. Two analog input circuits, low voltage and high voltage, with a voltage source for potentiometer transducers polarization. Low voltage measurement is translated into stroke and speed. In alternative, the input can measure the auxiliary DC voltage during circuit breaker operation.
. Static resistance measurement; test current 200 A, 100 A or 20A.
. Dynamic contact resistance test; test current 200 A, 100 A or 20A.
. Many triggers can start the recording.
. In case of more than two chambers per phase, capability of generating or sensing a trigger, so that a number of units can operate at the meantime.
. All possible test sequences are easy and simple programmable, including test cycling.
. Test result is shown on the display: it is possible to analyse, zoom and so on.
. Capability of storing and recalling both test settings and test results.
. The software TDMS (that operates with WINDOWS 7 up) is included: it allows analyzing test results, adding notes, saving and so on. It allows also to store and recall test settings and execute automatic tests.

All circuits have been designed to ensure safe operation in the noisy environment (electromagnetic interference) of EHV, HV or MV substations. For the instrument it is not necessary a field calibration; during the startup an internal check is executed.

The instrument is housed in a compact and rugged transportable aluminium box, that is provided with removable cover and handles for ease of transportation.

The following figure shows the CBA1000 front panel.

NOTE: WINDOWS is a trademark of MICROSOFT inc.

2 CHARACTERISTICS

2.1 COIL DRIVING CIRCUITS

. Number of circuits: two; optionally four.
. Type of driver: electronic; it ensures superior timing control.
. Driver characteristic: 300 V DC max; 30 A DC max, or 300 V AC max; 20 V AC max.
. Operating time accuracy: 0.025% of delay ± 100 us.
. Coil current ranges: 2.5; 10; 25 A full scale, user selectable.
. The coil current is measured by a dedicated circuit, which is enclosed in the test set, so that a single connection is enough to connect the coil and to measure its current.
. Number of coil current measurement circuits: two (optionally four).
. In case of four outputs, it is possible to select the single or multiple phase opening.
. Coil current measurement accuracy: 0.5% of the reading ± 0.1% of the selected range.
. Connection: via four (optionally eight) safety sockets.
. Outputs are isolated between them.

2.2 MAIN CONTACT INPUTS

. Number of main contact inputs: six in all, divided in three groups of two each.
. Test of the main contact and of the pre-insertion resistor contact, selectable.
. The contact is CLOSED when the contact resistance is less than 10 Ohm.
. Pre-insertion resistor contact range: 20 Ohm to 10 kOhm.
. Contact test voltage: 24 V. Main contact test current: 50 mA.
. Each input group is isolated with respect to the others.
. Connection: via nine safety sockets.
. When a main contact is closed, the corresponding light on the front panel turns on.

2.3 AUXILIARY INPUTS

. Number of auxiliary inputs: four, divided in two groups of two each.
. Each input group is isolated with respect to the other.
. Capability of testing dry contacts. Contact test voltage: 24 V; test current: 2 mA.
. Capability of testing wet contacts. Contact input voltage: 20 to 300 V; test current: 2 mA.
. Contact selection can be different on the two groups.
. Connection: via six safety sockets.
. When an auxiliary input is closed, the corresponding light on the front panel turns on.

2.4 INPUTS TIMING

. Sample rate: 20 kHz maximum for recording up to 1s; 2kHz for recordings from 1 to 10 s; 200Hz for recordings up to 100s; 100Hz up to 200s.
. Resolution: 0.1 ms to 1 s.
. Inputs timing accuracy: see the following table

RANGE	FREQUENCY	ACCURACY
1 s	20000 Hz	0.05 ms ± 0.025% of the reading
2 s	10000 Hz	0.1 ms ± 0.025% of the reading
4 s	5000 Hz	0.2 ms ± 0.025% of the reading
10 s	2000 Hz	0.5 ms ± 0.025% of the reading
20 s	1000 Hz	1 ms ± 0.025% of the reading
40 s	500 Hz	2 ms ± 0.025% of the reading
100 s	200 Hz	5 ms ± 0.025% of the reading
200 s	100 Hz	10 ms ± 0.025% of the reading
400 s	50 Hz	20 ms ± 0.025% of the reading
1000 s	20 Hz	50 ms ± 0.025% of the reading

2.5 ANALOG INPUT

. Number of analog inputs: Two, high voltage and low voltage, isolated between them..

2.5.1 High voltage analog input

. Input voltage ranges: ± 5 V; ± 50 V; ± 500 V DC (3.5; 35; 350 V AC), user selected. These ranges allow measuring all AC and DC voltages.
. Analog input measurement resolution: 16 bit.
. Analog input measurement accuracy: 0.5% of the reading ± 0.1% of the selected range, for DC inputs: 1 % of the reading ± 0.2% of the selected range, for AC inputs.
. Analog input impedance: more than 200 kOhm.
. Analog input measurement sampling rate: 20 kHz max.
. Connection: via two safety sockets for the input, plus two safety sockets for the polarizing voltage.

2.5.2 Low voltage analog input

. Input voltage range: ± 5 V.
. Analog input measurement resolution: 16 bit.
. Analog input measurement accuracy: 0.5% of the reading ± 0.1% of the selected range.
. Analog input impedance: more than 200 kOhm.
. Analog input measurement sampling rate: 20 kHz max.
. Availability of a polarizing voltage to supply linear position transducers. Voltage value: - 5 V; maximum output current 5 mA; minimum transducer resistance 1 kOhm. The output is isolated from other circuits.
. When the input is used with a position transducer, the software allows displaying: positions, strokes, speed (datum point). These measurements are defined by the position of the cursors. In this instance, it is possible to input the transducer stroke, and to set the unit of measurement as millimeters, degrees or inches.
. Connection: via a shielded connector for the input, and two safety sockets for the polarizing voltage.

2.6 TIME MEASUREMENT TRIGGERS

The following time measurement trigger options are user selectable:
. Internal: the time measurement starts as the first Open or Close coil command is issued by the driving circuit.

. Coil current: the time measurement starts as soon as the first Open or Close coil current exceeds the selected percentage, from 1% to 30%, of the selected current range.
. Auxiliary input: the time measurement starts when the selected auxiliary input turns ON or changes its state. The trigger can be performed also on a logical combination of auxiliary inputs.
. Analog input: the time measurement starts when the analog input level crosses (greater than, lower than) the selected threshold.
. External trigger. The test set features a Trigger Out output and a Trigger In input, that allow synchronizing up to 4 CBA1000's. In this mode, one CBA1000 acts as the Master unit; its Trigger Out output will be connected to all other units, selected as Slave. As the Master starts the test, all other Slave units will measure the timing on Main, auxiliary and analog inputs. Maximum timing error: 100 us. This feature allows to test circuit breakers with more than two chambers per phase, or to survey more than four auxiliary inputs, or to survey more than one analog input at a time.

2.7 PROGRAMMABLE SEQUENCES

The user can select the following Open and Close sequences:
. Open: the Open coil is driven. In case of four coils, the selected Open coil phase is driven.
. Close: the Close coil is driven.
. OC: In sequence, the Open and Close coils are driven. In case of four coils, the selected Open coil phase is driven.
. CO: In sequence, the Close and Open coils are driven. In case of four coils, the selected Open coil phase is driven.
. OCO: In sequence, the Open, the Close and then again the Open coils are driven. In case of four coils, the first Open command is issued on the selected Open coil phase, while the second Open command is issued on all coil phases.
Via the software, it is possible to repeat an OC or CO command up to 9999 times.

These sequences are also selected by means of a dedicated pushbutton; the selected sequence is confirmed by an LED.

For all the above sequences, the user can program the following delays:
. Open command duration: range 10 ms to 10 s.
. Close command duration: range 10 ms to 10 s.
. Open to Close delay: delay range 10 ms to 199.990 s.
. Close to Open delay: delay range 10 ms to 199.990 s.
. Recording duration: range 10 ms to 199.990 s.
. Two times recording. In this mode, the measurement is performed in two steps, separated by a pause: this avoids loosing the timing resolution of the part of interest. It is possible to program a first recording duration, then a pause, then the second recording duration.
. After programming, it is possible to view on the display the sequence timing: this helps avoiding programming errors.
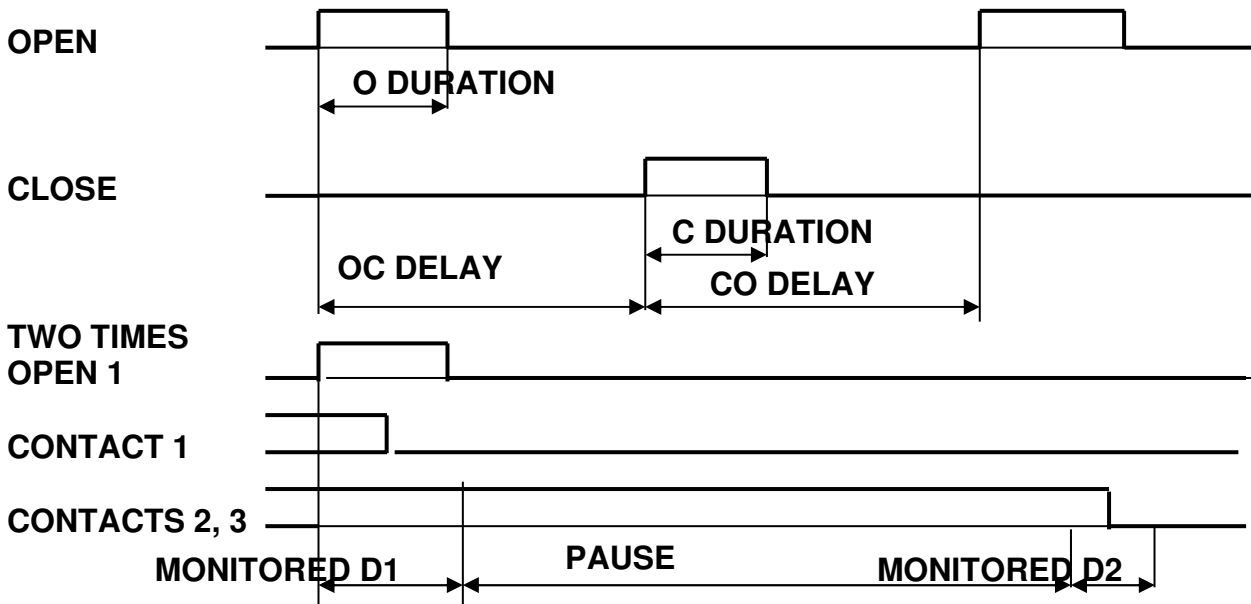
2.8 STATIC RESISTANCE MEASUREMENT (OPTIONAL)

This measurement is performed connecting CBA1000 to the test sample and measuring its resistance. Test samples can be: joints, main contacts and so on. Main contacts resistance is measured in the closed position.

. Test current, resistance measuring range, resolution and accuracy: see the table.

TEST CURRENT	RESISTANCE RANGE	RESOLUTION	ACCURACY
A	mOhm	µOhm	
200	0.2	1	2 % of the reading ± 0.5% of the range
	1	1	2 % of the reading ± 0.5% of the range
100	1	1	2% of the reading ± 0.3% of the range
	10	1	1% of the reading ± 0.3% of the range
20	10	1	1% of the reading ± 0.3% of the range
	100	1	1 % of the reading ± 0.2% of the range

. Type of current source: electronic constant current generator, driven by a discharging capacitor.
. Minimum duration of the current generation: 30 ms, @ 200 A.
. Capacitor charging time: 60 s.
. Maximum test voltage: 18 V.
. Test mode selection. With single test, the resistance value is displayed. With Breaker phase test, the screen shows a table that collects the measurement of all phases.
. NOTE: during the first 4 ms, the resistance measurement is affected by the connection leads inductance.

2.9 DYNAMIC RESISTANCE MEASUREMENT (OPTIONAL)

With this measurement it is possible to record the main contact resistance during the CB close.
The CB is open prior to test start: CBA1000 issues the Close command; as the contact closes, the test current passes through the contact, and CBA1000 measures the contact resistance variations during the close movement.
. Test current, resistance ranges and other characteristics: as for the static resistance measurement.
. Unlike the static resistance measurement, the test result is not a table of resistance measurements: it is the resistance profile during the test, along with voltage and current profiles.

2.10 TEST SET CONTROL

. The control is local, via keypad, selectors and display: no PC control is necessary.
. Keypad: 12 keys, numeric plus alphabet: it allows inputting all test references. The arrangement is the same as portable phones.
. Two dedicated pushbuttons for test start and sequence selection.
. Numeric encoder with pushbutton for menu selection (see below the selections list).
. As the test is started, a buzzer warns the operator.
. The graphical display has the following main features:
  - Type: transflective LCD;
  - Pixels: 320x 240;
  - Backlight color: white;
  - View area: 122 x 92 mm;
  - Displays: menu selections prior to test start; then, current waveforms, contact inputs (main – resistance), auxiliary inputs, analog input (those enabled). For dynamic resistance, it is possible to display the resistance profile, along with voltage and current profiles.
. Interfaces to PC: RS232, 57600 baud; USB.
. Memory size: 128 Mbytes (approx. 250 results).
. Maximum record length: 200 s.
. Capability of saving and re-calling up to 48 test settings.

2.11 PC SOFTWARE

The dedicated TDMS software has the following main features.
. Download of test sequences.
. Download of test results.
. Test sequences and test results can be viewed, edited in the missing descriptions, saved, printed, exported.
. Possibility of viewing, overlaying and gluing more results, for an easy test result comparison.
. Possibility to pre-set test sequences and to download them into the test set.
. Two cursors to select measurement points and intervals.
. Zoom in and out feature.
. Enhanced measurement features for movement – speed – acceleration control.
The software will be upgraded for free until a new version is released. Upgrading is simple: just connect to the ISA WEB site, and download the latest version. This applies also to the test set resident program.

2.12 MENU SELECTIONS

Appendix A lists the features that are menu selected. The menu is operated by means of the MENU control knob, that incorporates a switch. The menu is entered pressing the knob and selecting the item moving the knob. Once the item has been found and programmed, pressing the arrow the menu moves back, so that other programming can be performed.

After test start, measurements are displayed in the corresponding window. Pressing the knob it is possible to return to menu selections and modify them, and then it is possible to return to the measurements window.

Any setting can be saved to and recalled from the memory, with a line of text description. At power-on, the default one is displayed: it can also be recalled as necessary. Settings are permanently stored in the memory; new settings can be written to the same address after confirmation. For normal mode operation it is possible to recall the standard setting, that cannot be modified.
During the test, test results can be stored in the memory, according to selections.

2.13 OTHER CHARACTERISTICS

. Mains supply:
　　.. From 85 to 265 V AC; 50-60 Hz,
　　.. From 100 to 350 V DC.

. Maximum supply current: 1 A @ 85 V AC; power consumption 85 VA.

. Test set operation: from the mains, or from an internal battery. Battery characteristics:
　　.. Type: Ni-Mh, rechargeable.
　　.. Battery operating time: 4 hours (CB tests); 1 hour (microhmmeter).
　　.. Battery charging time: 8 hours.

. Housing: aluminium case, with hinged removable cover and handles.

. The instrument comes complete with the following items:
　　.. Mains cable;
　　.. User's manual;
　　.. Serial cable;
　　.. USB cable;
　　.. One cable, yellow/green, for the connection to ground. Cable length: 4 m; cross section 1 sq. mm, terminated with a crocodile;
　　.. Spare fuses;
　　.. Software TDMS.

. Dimensions: 400 (W) * 300 (D) * 240 (H) mm.
. Weight: 10 kg.

3 OPTIONS

Options 1 to 4 are to be specified at order, even if it is possible to install them later on.

3.1 STATIC AND DYNAMIC RESISTANCE MEASUREMENT, CODE PII23166.

The option performances are described at paragraphs 2.8 and 2.9. Physically, it is made of a printed circuit board, to be mounted on the mother panel, and of a capacitor, to be mounted on the base. Even if it is possible to upgrade CBA1000, it is advisable to request the option at order: see below for the CBA1000 coding. In case of an order after CBA1000 delivery, use the code in the title.

3.2 FOUR COILCOMMANDS, CODE PII43166.

With this option the test set is provided with the circuits to drive four coils (three Open, one Close), rather than two. The option is made of an additional printed circuit board that fits into the mother board.
Even if it is possible to upgrade CBA1000, it is advisable to request the option at order: see below for the CBA1000 coding. In case of an order after CBA1000 delivery, use the code in the title.

3.3 INTERNAL PRINTER, CODE PII33166.

CBA1000 can be provided with a built-in thermal printer. Printer characteristics:
-   Type: thermal;
-   Paper width: 58 mm;
-   Recordings: the selected window.
This option is exclusive of the DC loss test.
Even if it is possible to upgrade CBA1000, it is advisable to request the option at order: see below for the CBA1000 coding. In case of an order after CBA1000 delivery, use the code in the title.

3.4 EXTERNAL PRINTER, CODE PII14102.

Thermal printer, for the printout of all test results.Paper 112 mm wide.

3.5 MINIMUM TRIP COIL TEST.

These options have the purpose of allowing to test the behaviour of the Minimum Trip Coil circuit and of Open or Close coils, when supplied at a reduced voltage.
There are two modules available: one, code PII34166, is for battery voltages up to 250 V; the other one, code PII24166, is for battery voltages up to 70 V.
The option is to be connected to the auxiliary DC supply of the plant; the option output voltage can be modified (stepped or ramped down), according to the test program.

This option is exclusive of the internal printer.
Even if it is possible to upgrade CBA1000, it is advisable to request the option at order: see below for the CBA1000 coding. In case of an order after CBA1000 delivery, use the code above.

Options characteristics:

OPTION	PII34166	PII24166
Absolute maximum voltage	250 V	70 V
Maximum operating voltage	240 V	50 V
Minimum operating voltage	50 V	16 V
Maximum voltage drop	120 V	45 V
Minimum voltage drop	10 V	5 V
Adjustment step	2 V	0,5 V
Adjustment accuracy	2 V	0,5 V
Maximum output current	4 A; dV< 60 V; 2 A; dV> 60 V	10 A; dV< 12 V; 5 A; dV> 12 V
Maximum test duration	500 ms	500 ms
Pause duration	20 s	20 s

. Connections: one input safety socket, to be connected to the auxiliary supply positive, and one output safety socket, to be connected to the minimum voltage input.
. Voltage adjustment in steps.
. Over-current protection.

3.6 TEST SET CODES WITH OPTIONS.

The following table lists the possible CBA1000 configurations and the corresponding coding.

CBA1000	µOHMMETER	PRINTER	4 COILS	250 V DC LOSS	70 V DC LOSS	CODE
YES	-	-	-	-	-	PII10166
YES	YES	-	-	-	-	PII20166
YES	-	YES	-	-	-	PII30166
YES	-	-	YES	-	-	PII40166
YES	YES	YES	-	-	-	PII50166
YES	YES	-	YES	-	-	PII60166
YES	-	YES	YES	-	-	PII70166
YES	YES	YES	YES	-	-	PII80166
YES	-	-	-	YES	-	PII31166
YES	YES	-	-	YES	-	PII51166
YES	-	-	YES	YES	-	PII71166
YES	YES	-	YES	YES	-	PII81166
YES	YES	-	YES	-	YES	PII61166

3.7 CONNECTION CABLES, BASIC SET.

The connection cables set includes:
.. Three cables for the connection to the main contacts, each of three conductors. Cable length: 16 m; cross section 1.5 sq. mm; terminated with safety banana plugs, with colors: black, red, blue, on one side, and with crocodile clamps on the other side.

.. Two cables for the connection to the auxiliary contacts, each of three conductors. Cable length: 6 m; cross section 1.5 sq. mm; terminated with safety banana plugs on both sides, with colors: black, red, blue. The two cables are marked with labels.

.. One cable with four conductors for the connection to the CB coils. Cable length: 10 m; cross section 1.5 sq. mm, terminated with safety banana plugs on both sides; colors: black; red, blue, yellow.

.. One shielded cable for the measurement of the low voltage, including two conductors. Cable length: 10 m; cross section 0,5 sq. mm. Terminated with the suitable connector on the CBA 1000 side, and with two clamps on the CB side.
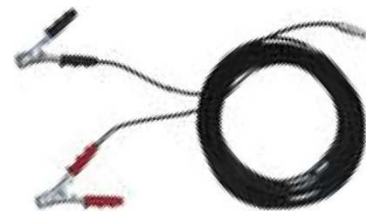
.. Five cables banana to banana: one red, two black, two blue.

.. Three jumpers, with 2 safety plugs, 10 cm long, for the connection of coil drivers to the supply.

.. Fourteen adaptors from female banana socket to terminator, length 20 cm. Three colors: 6 red; 6 black; 2 blue.

.. One set of 8 crocodiles, for the connection to auxiliary contacts, plus 2 more, for the 500 V measurement.

.. One 4-way cable for connect Trasducers. Cable is 10 meter long, and terminated onone side with safety 4 mm banana plugs and on other side with male measure connector.

.. One plastic bag that hosts all the cables.

If the micro-ohm meter option is included, the following connection cables are provided:

.. Two current conductors, marked red and black. Cable length: 10 m; cross section 25 sq. mm. Terminated with a suitable terminator on the CBA1000 side, and with an high current crocodile on the CB side.

If the four coils drive option is included, the following additional connection cables are provided:

.. One cable with four conductors for the connection to the CB coils. Cable length: 10 m; cross section 1.5 sq. mm, terminated with safety banana plugs on both sides; colors: black; red, blue, yellow.
Two jumpers, with 2 safety plugs, 10 cm long, for the connection of coil drivers to the supply.

If the MTC option is included, the following additional connection cables are provided:

.. One cable, single conductor, for the connection to the positive auxiliary supply. Cable length: 4 m; cross section 1.5 sq. mm, terminated with safety banana plugs on both sides; color: black.

.. Two cables, single conductor, for the connection to the MTC coil. Cable length: 2 m; cross section 1.5 sq. mm, terminated with safety banana plugs on both sides; color: red.

The code of the option changes with the additional options, as follows.

CBA1000	μOHMETER	4 COILS	MTC	CODE	GOES WITH
YES	-	-	-	PII15166	PII10166
YES	YES	-	-	PII25166	PII20166
YES	-	YES	-	PII45166	PII40166
YES	YES	YES	-	PII65166	PII60166
YES	-	-	YES	PII35166	PII31166
YES	YES	-	YES	PII55166	PII51166
YES	-	YES	YES	PII75166	PII71166
YES	YES	YES	YES	PII85166	PII81166

3.8 LONG CONNECTION CABLES SET.

This option is the same as the former one, unless the first two cables, which are replaced with the following ones.

CABLE #1 NO. 3 Cables for connection to Main contacts; Cables (3G1,5) are 28 meters long and mounted on cable roll. Cables are terminated with clamps.

NO.3 Cables for connection to CBA; Cables (3G1,5) are 2 meters long and terminated on both sides with safety 4 mm banana plug.Cables are marked withlabel **"1"** .

CABLE #2 NO. 2 Cables for connection to Auxiliary contacts; Cables (3G1,5) are 10 meters long and terminated on both sides with safety 4 mm banana plug. Cables are marked withlabel **"2".**

3.9 TRANSIT CASE, CODE PII18166.

The transit case allows delivering CBA1000 with no concern about shocks up to a fall of 1 m.
Characteristics:
. Black plastic case;
. Dimensions: 670 mm (w) x 500 mm (h) x 350 mm (d).
. Weight : 9.5 kg.

. Provided with handle and wheels.

3.10 SOFT PROTECTION BAG, CODE PII19166.

The soft protection bag hosts CBA1000 and protects it against dust and scratches.
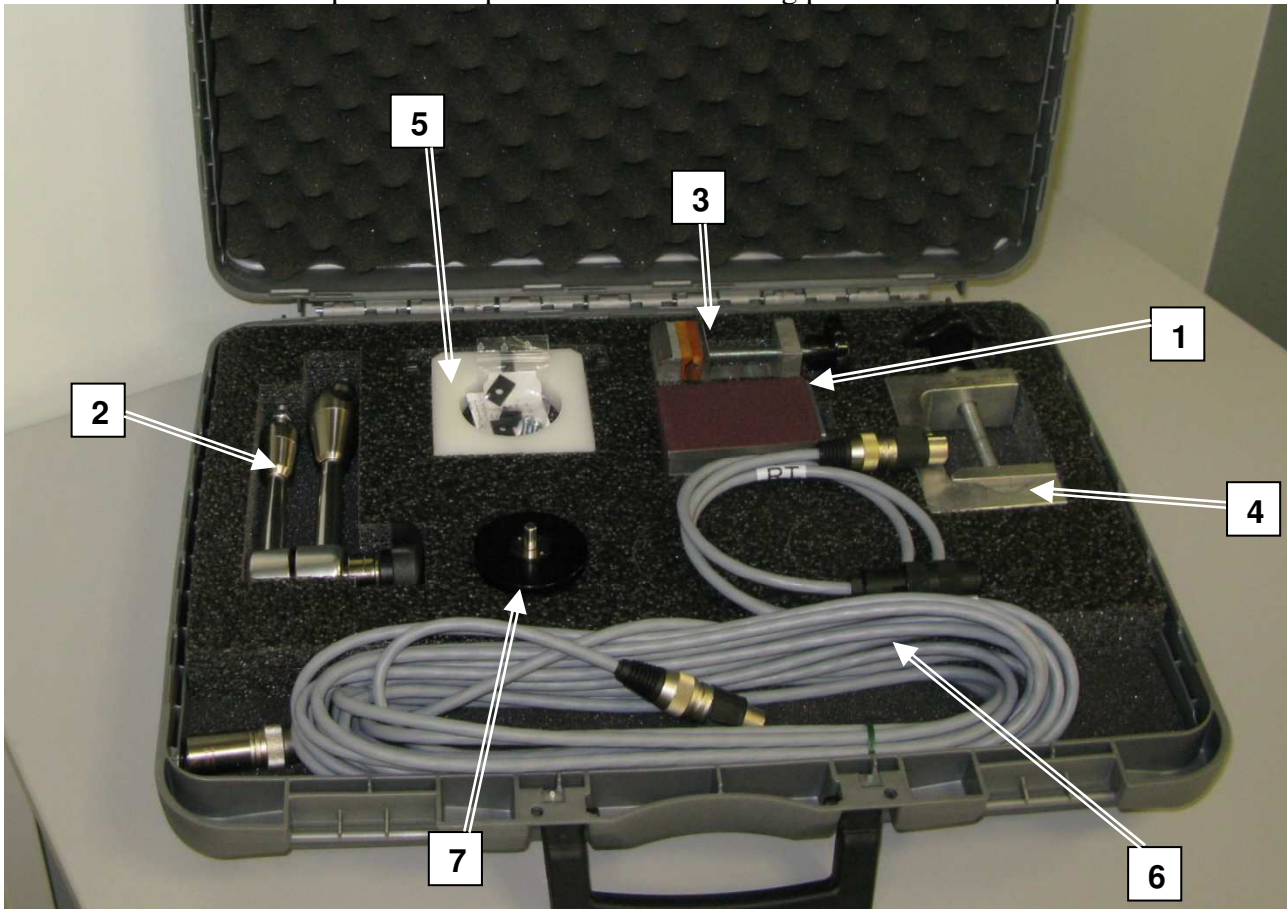

3.11 TRANSDUCERS.

We have a set of optional transducers, linear and rotating. Linear transducers have different strokes, and also different IP protections: low for the TLH series, high for the LWG series. A mounting kit is also available. The table summarizes characteristics and codes.

TYPE	DESCRIPTION	STROKE (mm)	CODE
LINEAR	TLH150	150	PII11166
LINEAR	TLH225	225	PII12166
LINEAR	TLH500	500	PII13166
LINEAR	LWG150	150	PII26166
LINEAR	LWG 225	225	PII27166
LINEAR	LWG 500	500	PII28166
ROTATING	-	-	PII14166
-	MOUNTING KIT	-	PII16166

The mounting kit includes the following materials:
. N. 1 Magnetic support (1). The magneticbase is 50 x 80 mm;
. N. 1 Adaptive arm (2). The length of the two parts are 130 and 160 mm, the maximum distance is 290 mm;
. N. 1Small mechanical clamp (3). The maximum opening is 40 mm;
. N. 1 Big mechanical clamp (4). The maximum opening is 65 mm;

. N. 1 Support for the rotating transducer (5). Purpose of the magnetic support or clamps is to provide the base for the arm. To the other end of the arm is screwed to rotating transducer support.
The kit is included into a plastic transport case. The following picture shows the open case.

. N. 1 Connection cable (6), 10 m long.
. N. 1 Rotary transducer (7) (or linear transducer, or both).

The rotating transducer comes with its flexible joint. The sketch of the joint is the following one.
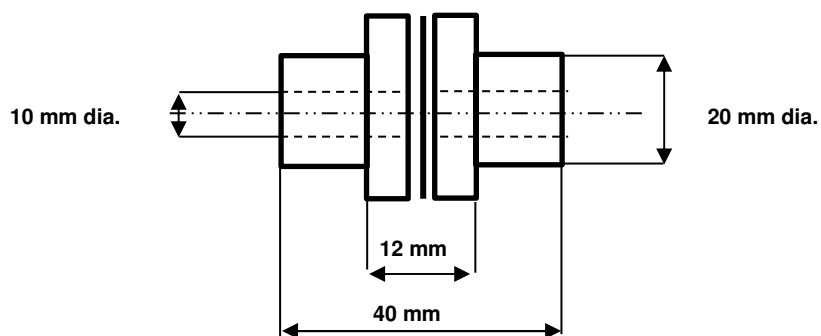
3.12 HALL EFFECT CLIP-ON TRANSFORMER, CODE PII29166.

Hall effect clip-on transformer: it allows measuring the DC current of motors and of the auxiliary supply. Main characteristics:
. Metering: AC and DC currents.
. DC measurement null with a knob.
. Ranges: 10 mV/A, 80 A DC, 40 A AC maximum, and 1 V/A, 2 A DC, 1.5 A AC maximum.
. Low battery indicator.

. Measurement errors: 4% of reading + 20 mA for the 80 A range; 2% of reading + 5 mA for the 2 A range.
. Phase shift (up to 65 Hz): maximum 1°.
. Maximum working voltage: 600 V rms.
. Power supply: alkaline 9 V battery, type 6 LR 61.
. Service life: 70 h typical.
. Maximum cable diameter: 10 mm.
. Weight: 330 g.
. Dimensions: 65 mm wide (clamp closed); 36 mm thick; 230 mm long.

4 PROTECTIONS

- Fuse on the mains supply.

- At power-on, a diagnostic sequence controls the microprocessors. If something is wrong, the operator is alerted by a message.

- The test is started pressing the START pushbutton, and then also pushing the multifunction knob.

- During the test, the circuits driving the coils give alarm messages in case of: selected current range exceeded; coil driver over-temperature.

- During the test, if the trigger criteria (coil current, auxiliary input, analog input) is not met within the maximum test time, the test set displays a warning message.

- The 5 V transducer supply is protected against short circuit on the output, and against contact with a voltage up to ± 500 V. In both instances, the circuit is not damaged.

- All inputs and outputs are isolated between them.

APPENDIX A: MENU SELECTIONS

LEVEL 1	LEVEL 2	LEVEL 3	LEVEL 4
1 TRIGGER OPTIONS	**1 Coil current**	% of range (1 to 99)	
	2 Coil command		
	3 Coil command reset		
	4 Analog input	1 Threshold, + or -	
		2 Input range	
	5 External trigger on Slave input		
	6 Auxiliary input	1 Channel number	
		2 Logic level: NO, NC, TRANSITION	
		3 Logic: AND, OR	
2 TEST OPTIONS	**1 Open**	A, B, C, AB, BC, CA, (*)	
	2 Close		
	3 Open – Close		
	4 Close – Open		
	5 Open – Close – Open		
	6 With 4 coils option	MTC timing	
	7 Optional MTC	1 Low battery test	
		2 MTC threshold	
		3 MTC timing	
	8 Tolerances	Max trip time	
		Max close time	
		Pole discrepancy open	
		Pole discrepancy close	
		Contact discrepancy open	
		Contact discrepancy close	
3 RECORDING OPTIONS	**1 Open coil duration**		
	2 Close coil duration		
	3 Open to close delay		
	4 Close to open delay		
	5 Pretrigger duration		
	6 Sample frequency		
	7 Recording duration		
	8 Two recordings	1 First duration	
		2 Dead time	
		3 Second duration	
	9 Help diagram	Timing diagram	

LEVEL 1	LEVEL 2	LEVEL 3	LEVEL 4
4 BREAKER AND AUXILIARY CHANNEL SETTINGS	**1 Breaker contacts**	A1; A1+B1+C1; all	
	2 Pre-insertion resistor test	Enable/disable	
	3 Auxiliary inputs 1-2	Enable/disable; label; dry/wet	
	4 Auxiliary inputs 3-4	Enable/disable; label; dry/wet	
5 ANALOG CHANNEL/COILS SETTINGS	**1 Close coil range**	2.5,10,25 A	
	2 Open coils range	2.5,10, 25 A	
	3 Analog input	1 Enabled	
		2 500 V input range, label	500,50,5 V DC
		2.1 AC input	Yes, no
		3 Travel transducer	Input: 5 V, 500 V
			Label
			Phase
			Transducer: U.M.;
			Transducer: max stroke
			Supply: 5V int, ext
			Breaker: U.M.;
			Breaker: stroke;
			Nominal transducer stroke
		Travel transducer calibration	Open position, %
			Closed position, %
			Actual tr. stroke, %
			Tr. stroke error, %
			Actual bk. stroke, %
			Bk. stroke error, %
		Datum points definition	Enable
		From open to closed	At open position
			At closed position
			At CB opening
			A point set-up
			B point set-up

* Only with the four coils option

LEVEL 1	LEVEL 2	LEVEL 3	LEVEL 4
		From closed to open	At open position
			At closed position
			At CB opening
			A point set-up
			B point set-up
		Slow motion	A bound
			B Bound
			B position
			A extra stroke
			B extra stroke
			CB stroke
		4 Pressure transducer	Input: 5 V, 500 V
			1 U.M. (Bar, ..)
			2 Pressure at zero voltage
			3 Volt per pressure
		5 Clip-on transformer	Input: 5 V, 500 V
			1 Label
			2 I/V ratio
			3 Max I
6 MICROOHMMETER	**1 Disabled**		
	2 Static contact resistance	1 Nominal test current	20, 100, 200 A
		2 Resistance range	200uOhm; 1; 10; 100 mOhm
		3 Test mode	1 Single
			2 Breaker phase
			3 Hybrid type
	3 Dynamic contact resistance	1 Nominal test current	20,100, 200 A
		2 Resistance range	200uOhm; 1; 10; 100 mOhm
		Transducer test	Yes, no
7 RESULTS	**1 Save result**	Result name	
	2 Load result	List of results	
	3 View result	List of results	
	4 Delete result	List of results	
	5 Rename result	List of results	

LEVEL 1	LEVEL 2	LEVEL 3	LEVEL 4
8 PREFERENCES	**1 Date and time**		
	2 Display	1 Contrast	
		2 Backlight duration	
	3 Time measurement	ms; 60 Hz cycles; 50 Hz cycles	
	4 Buzzer	Yes - No	
	5Print diagrams	Yes - No	
	6 Filtered waveforms	Yes-No	
	7 Original waveforms	Yes-no	
9 SETUP options	**1 Save setup**	Name	
	2 Load setup	List of files	
	3 Delete setup	List of files	
	4 Show setups	Name; trigger…	
	5 Show current setup	Name; trigger…	
	6 Restore default		
10 Tests header	**Plant, feeder..**		
11 Test diagram	**Diagrams**		
	Setup shortcut		
	Results table		
	Select display wave		
	MicroOhm shortcut		
	Menu access		
	Function keys Help		
	Zoom in-out		
	Time measurements		
	Print		

S P E C I F I C A T I O N   isa

ALTANOVA HEADQUARTER

ISA - Altanova Group S.r.l.
via Prati Bassi 22, 21020 Taino (Va) – ITALY
Phone +39 0331956081
Fax +39 0331957091
Email isa@doble.com

REGIONAL OFFICES

ALTANOVA INDIA Pvt. Ltd.
C-33, Ground Floor, Sector-2, NOIDA-201
301, Uttar Pradesh, INDIA
Phone +91120 4543853 / 54 / 4222712
Email: isiddiqui@doble.com

ISA PACIFIC PTE Ltd
62 Ubi Rd 1, #11-14, Oxley Bizhub 2
Singapore, 408734
Phone +65 62782381
Email: ichan@doble.com

ALTANOVA GROUP SOUTH AMERICA
São Paulo, BRASIL
T +5511 96335 - 3518
Email: rarregalo@doble.com

ALTANOVA GROUP CENTRAL AMERICA
Villas Alpinas, 8th Street, #88D
T +507 65503173
Email: dquintero@doble.com

ALTANOVA GROUP GCC
Office no 1206, Park Avenue, P.O. Box: 10159 , Dubai Silicon Oasis, United Arab Emirates
Mobile: +971 55 5146998 / +971 55 5165793
Phone: +971 42545045
Email: altanovagcc@doble.com

TECHIMP GERMANY GMBH
Bahnhofstraße 76, 31691 Helpsen
Germany
T: +49(0)1702364735
Email : mhesse@doble.com

ALTANOVA GROUP FRANCE & MAGHREB
70 boulevard Anatole France, 93200 Paris
France
T: +33 6 73691137
Email: fcausse@doble.com