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CBA1000
INTRODUCTORY GUIDE

SHORT FOREWORD

Dear CBA1000 user,

I often wondered why the user's manual is not very much used, even if it includes valuable information. As me too I am a user of such manuals, the answer I have given myself is that valuable information are concealed somewhere in the thick thing, and I do not have time to waste to find it. So, either the manual is actually of help, or I ignore it.

This is why I decided to split the CBA1000 manual in three: specification, with all performance details; introductory guide, with the device description; application manual, with instructions about how to use it one its operation is understood. The idea is that you may read once the introductory guide or the specification, while you need to follow application examples more than once; so, why not to split the manual in three?

This manual is the introduction to the test set; it includes also a troubleshooting guide.

Have a good work with CBA1000!

Primo Lodi
Q&A Manager

1 INTRODUCTION

The circuit breaker analyzer and micro-Ohmmeter 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 and HV circuit breakers.

When used as a micro-Ohmmeter, 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).
. Optional internal thermal printer 58 mm wide or external thermal printer 112 mm wide.
. Huge recording capability: 64Mb (typically 1000 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..
. One analog circuit input circuit, with a voltage source for potentiometer transducers polarization. Measurement is translated into stroke, speed, acceleration. In alternative, the input can measure the auxiliary DC voltage during circuit breaker operation.
. Static resistance measurement; test current 200 A, 80 A or 25A.
. Dynamic contact resistance test; test current 200 A.
. 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 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 CBA1000.PRO (that operates with WINDOWS 2000 up) is included: it allows analyzing test results, adding notes, saving and so on. It allows also to store and recall test set settings.
. The external option DET1000 allows to perform the test while the circuit breaker has both ends connected to earth, thus maximizing the test safety; it allows also to test circuit breakers with a graphite nozzle.

All circuits have been designed to ensure safe operation in the noisy environment of HV and MV substations.

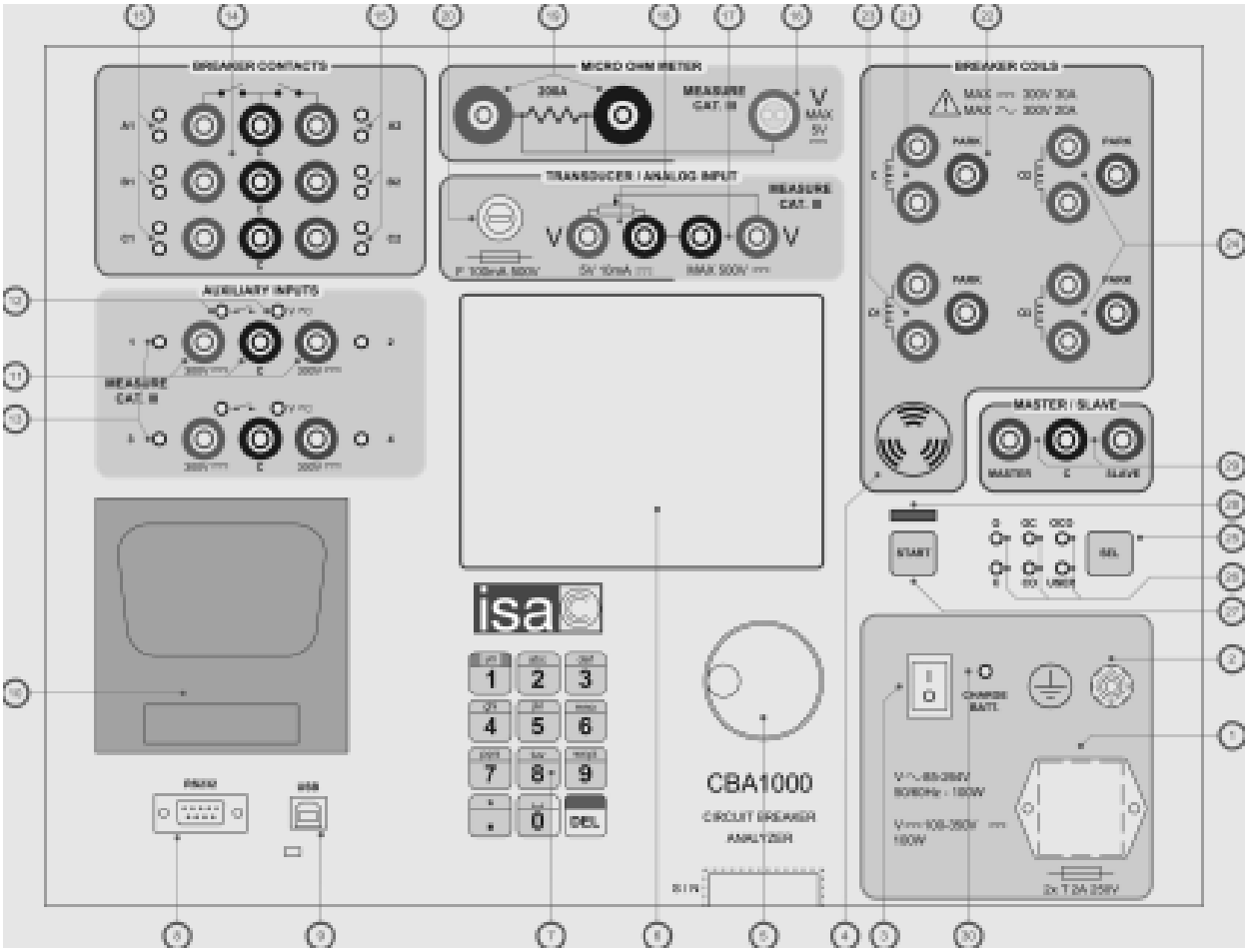
The instrument is housed in a transportable aluminium box, that is provided with removable cover and handles for ease of transportation.

NOTE: WINDOWS is a trademark of MICROSOFT inc.

2 TEST SET EXPLANATION

2.1 THE FRONT PANEL AND THE KEY COMPONENTS

The following is the front panel; all components on the front, and the key ones inside the test set, are listed here below (see also the CBA1000 schematic at the end of the manual).



1) Supply socket and main supply fuse, rated T5A, incorporated in the supply socket.
2) Earth socket.
3) Power-on switch, with light.
4) Buzzer: it tells that the test is about to be started.
5) MENU control knob, with switch.
6) Display: before testing it allows to select the test parameters; after test start it displays test results.
7) Keypad, alpha-numeric, to input the test heading.
8) Serial interface connector.
9) USB interface connector.
10) Options: 40 columns thermal printer, or auxiliary supply loss test.
11) Auxiliary inputs sockets: two groups of two contacts, isolated.

12) Auxiliary inputs: dry or wet selection lights.
13) Auxiliary inputs level: ON = closed or with voltage.
14) Main contacts input sockets: three phases with two chambers each.
15) Main inputs lights: GREEN = main input CLOSED; RED = main input OPEN or pre-insertion resistor.
16) 5 V DC measurement input connector, for the micro-Ohmmeter circuit.
17) Measurement input sockets, for position transducers or other measurements.
18) Auxiliary 5 V 10 mA supply for the position transducer.
19) High current output sockets for the micro-Ohmmeter.
20) Auxiliary 5 V supply protection fuse, F 63 mA 500 V.
21) CLOSE coil command sockets: one side will be connected to the positive or to the negative of the DC supply.
22) PARK sockets, unconnected, for the safe positioning of coil commands.
23) OPEN coil command sockets: one side will be connected to the positive or to the negative of the DC supply. It drives phase 1 if the three phase open option is present.
24) Optional OPEN coil command sockets, for phases 2 and 3: one side will be connected to the positive or to the negative of the DC supply.
25) Type of test selection pushbutton: as pressed, lights (26) move in a circular way. If unused, the selection performed via knob (5) and display (6) is shown.
26) Selected test lights. O = Open; C = Close; OC = Open-Close; CO = Close-Open; OCO = Open – Close – Open; USER = the programmed test sequence.
27) Test START push-button: as pressed, the selected test is started.
28) Test in progress lights: they are ON until the test is finished. When ON, no further START command is accepted.
29) TRIGGER-IN and TRIGGER-OUT synchronization commands sockets. The Master CBA-1000 TRIG-OUT socket and zero sockets shall be connected to the Slave TRIG-IN and zero sockets.
30) Battery LED: it turns on during battery recharge.

60) Front panel board; code PWA11430.
61) Microprocessor board, code PWA51300.
62) INTE main and auxiliary contacts board, PWA11429.
63) Circuit breaker driver (2 channels) and measurements board, PWA11428.
64) Optional circuit breaker driver (2 channels) and measurements board, PWA11428.
65) Micro-Ohmmeter circuit board, with 14 driving circuits.
80) Rechargeable battery.
81) Auxiliary supply voltages module.
82) Capacitor of the micro-Ohmmeter circuit.

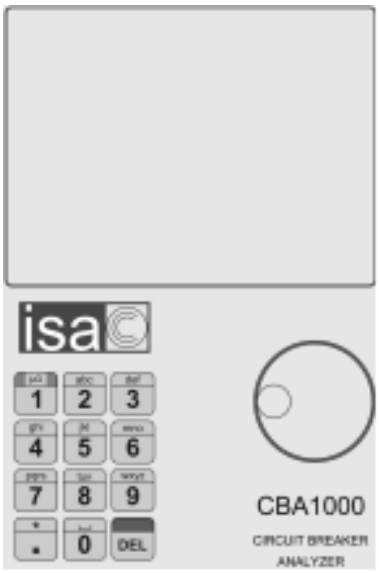
2.2 PUSHBUTTONS, DISPLAY, KEYPAD, CONTROL KNOB

The test set is controlled by two push-buttons: SELECT (25), with its LED's (26) showing the current selection 

, and START (27) with the light (28) 

, that starts the test.

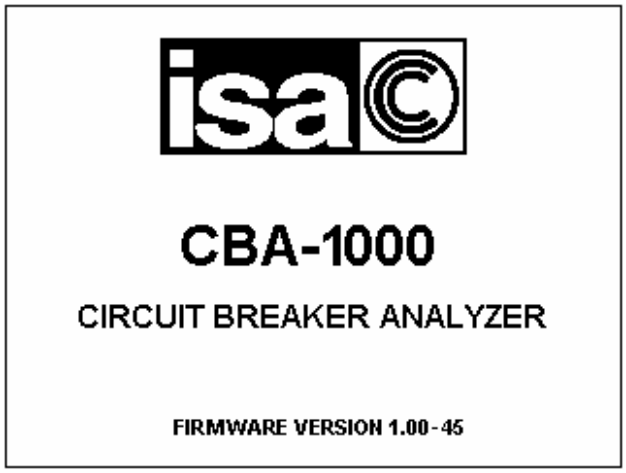
Test selections are performed by the keypad (7), control knob (5) and display (6).



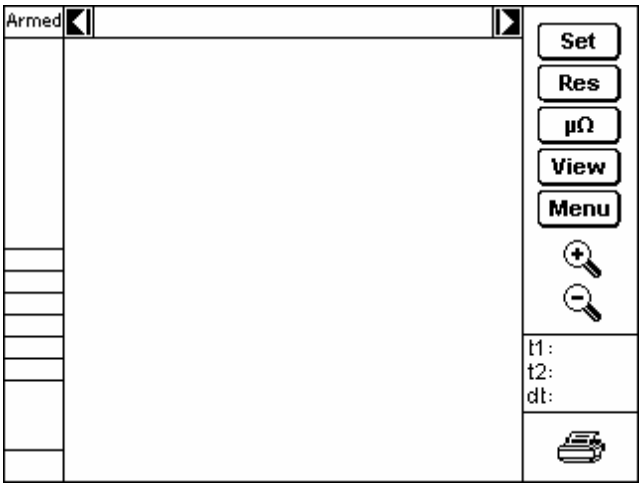
As With portable phones, pressing a button you access, in sequence, the letters, then the digit. Above the zero is the space.

2.3 THE CONTROL WINDOW

After power-on, the following window is displayed: it informs about firmware revision.



After diagnostics, the following control window is displayed.



Selections to the right are short-cuts that allow to enter the corresponding selections. They can be reached by means of the control knob (5), that incorporates a switch: this is possible selecting the item moving the knob, and then pressing the knob to confirm. Once the item has been reached, moving the knob the menu moves forwards backwards of one step, so that other programming can be performed; else, selecting the arrow the menu returns to the main window.

2.3.1 Set

This selection is a short-cut to the “Setup options” selection of the Menu; see below.

2.3.2 Res

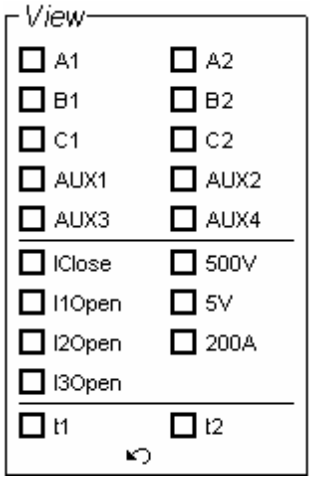
This selection is a short-cut to the “Results” selection of the Menu; see below.

2.3.3 Micro-Ohmmeter

This selection is a short-cut to the “Micro-Ohmmeter test” selection of the Menu; see below.

2.3.4 View

With this selection, it is possible to choose which channels will be displayed on the screen: this serves to minimize the number of traces. Next to this selection, the display self-adjusts so that, so that it is easier to watch test results. Pressing View, the following window is opened.

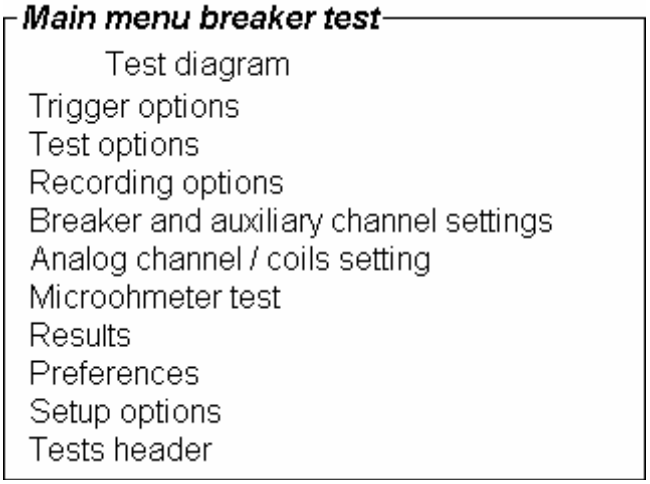


The left side of the screen follows the selection.

NOTE: this selection is independent from other selections, and all selected channels are saved into test results. On the same result, you can temporarily select to view on trace only, so that it can be examined at ease.

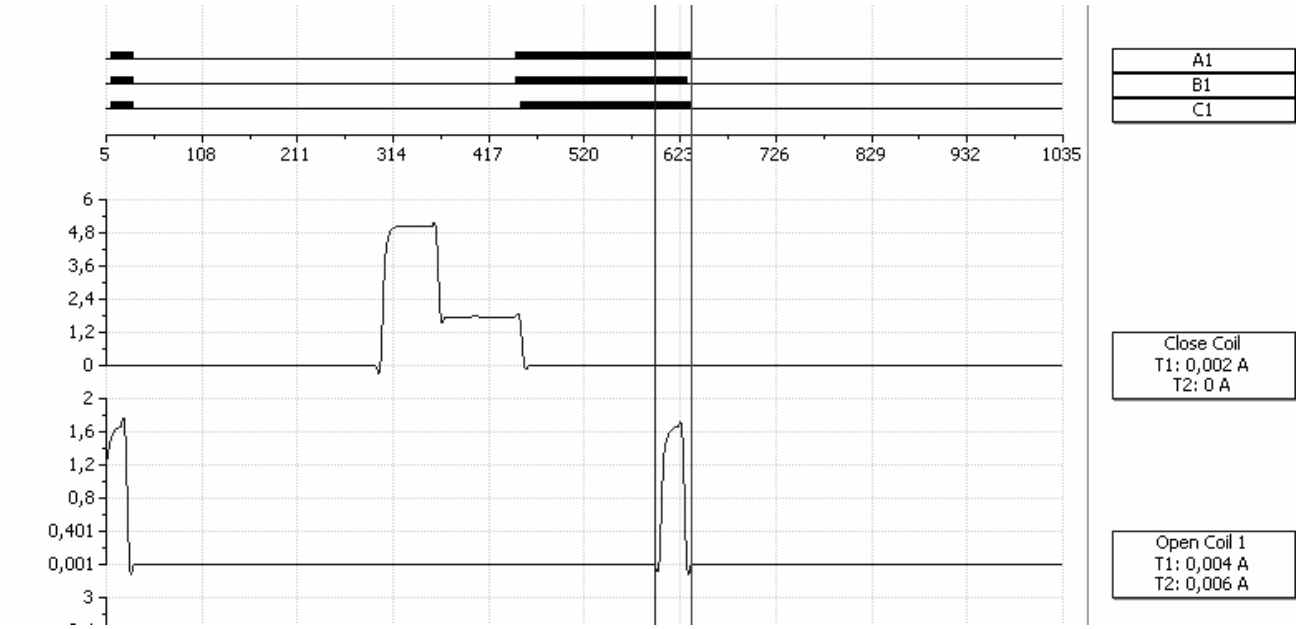
2.3.5 Menu

With this selection, the following window is opened.



2.3.5.1 Test diagram

This is the selection that allows you to come back to the test control: the test diagram is displayed, it is possible to start the test and to watch test result. The following is the example of a test diagram.



Main contact lines mean:
. Thin line = Open contact;
. Thicker line = pre-insertion resistor closed;
. Thickest line = Closed contact.

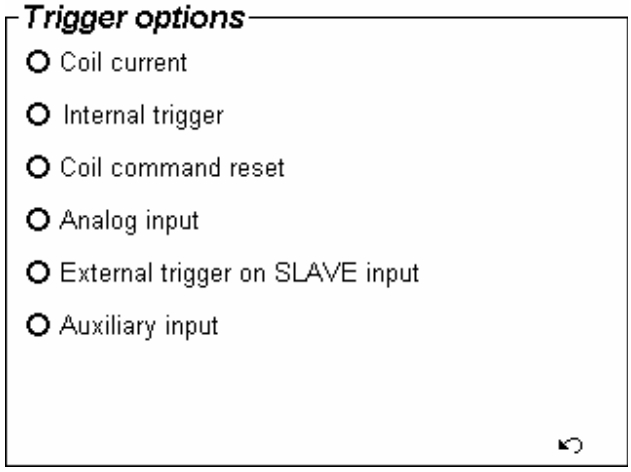
Auxiliary lines are: Thin = Open; Thick = Closed.

Next lines are the coil currents profiles: they are four if the option is installed.

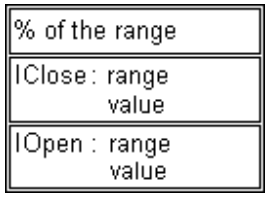
The time base is the test duration, with a scale that corresponds to the test time.

2.3.5.2 Trigger options

The selection defines the reference for time measurements: pressing it, the following window is displayed.



- The “Coil current” selection means that the timing is measured with the reference to the first coil current detected, being it Open or Close, according to the test sequence. Next window allows to select the coil current threshold percentage, from 1% to 30%, of the selected current range, that is displayed: coil range selection is performed accessing “Analog channel / coils setting”.

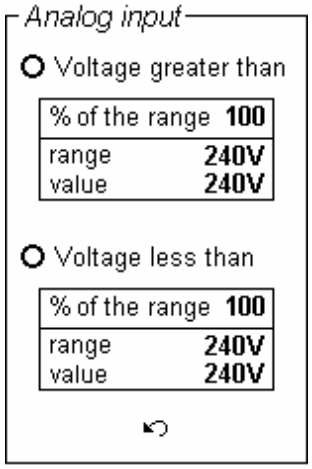


This selection was used in the past, when coil drivers were made of relay contacts that bounced in a way that the accurate time measurement was made difficult, and has been provided for comparison with older test results. Also, changing the current threshold changes the timing result, as the current increases slowly, because of the coil inductance. With CBA1000, coil driving is electronic: the voltage edge is steep, and there is no bounce; so, the internal trigger selection is preferable. The difference between the two selections is in the order of 1 ms.

- The “Internal trigger” selection means that the time measurement starts as the first Open or Close coil command is issued by the driving circuit.

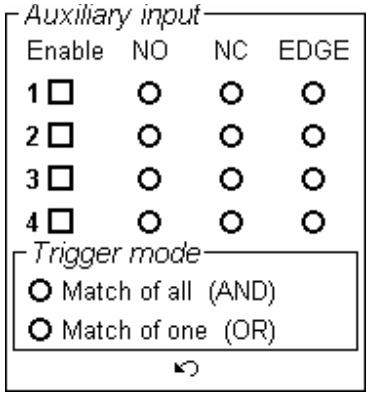
- The “Coil command reset” selection means that the time measurement starts as the Open or Close coil command drops.

- The “Analog input” selection means that the time measurement starts when the analog input level crosses (greater than, lower than) the selected threshold. Next window allows to select the analog input threshold:



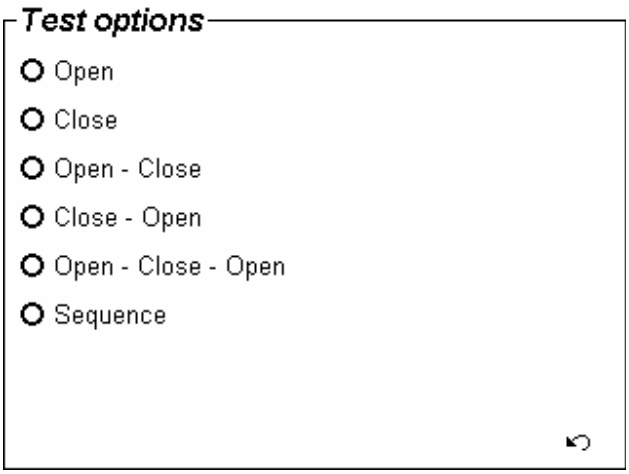
- “External trigger on Slave input” selection. The test set features a Master output and a Slave input (29), that allow synchronizing up to 4 CBA1000’s (1 Master, 3 Slave). In this mode, one CBA1000 acts as the Master unit; its Master output will be connected to all other units, selected as Slave. As the Master starts the test, all other Slave units will measure the timing on Main, auxiliary and analog inputs, but don’t generate coil driving signals. 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.

- The “Auxiliary input” selection means that 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. The choice is performed on the following window.



2.3.5.3 Test options

The selection defines the type of test: pressing it, the following window is displayed.

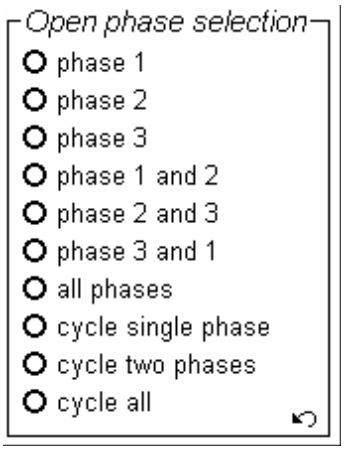


NOTE: the selected option is displayed by LED's by the side of the SEL pushbutton  .

If the operator acts on SEL, opening this window the performed selection is repeated.

This selection is useful in case of:
. Definition of Open commands if the of four coil drive option is available;
. Definition of the test sequence.

- With the "Open" selection, CBA1000 issues an Open command and records timings, according to other selections. In case of four coils, the selected Open coil phase is driven: selections are performed in the following window.



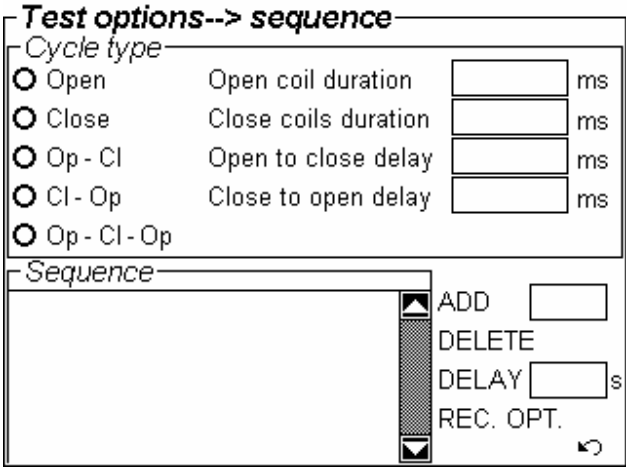
The selection “Cycle single phase” means that, in a series of Open commands, the first Open command will be issued on phase A; next Open command will be issued on phase B; next Open command will be issued on phase C. With further Open commands the cycle will be repeated.

The selection “Cycle two phases” means that, in a series of Open commands, the first Open command will be issued on phases A and B; next Open command will be issued on phases B and C; next Open command will be issued on phases C and A. With further Open commands the cycle will be repeated.

The selection “Cycle all” means that, in a series of Open commands, they will be: Phase A; Phase B; Phase C; Phases AB; Phases BC; Phases CA; Phases ABC. With further Open commands the cycle will be repeated.

- With the “Sequence” selection, the user can edit the desired test sequence. This gives the following possibilities:
. Issue a sequence of Open and Close commands: up to 200 commands can be programmed. With this selection it is possible to program the delay between OC commands: delay range 30 to 999 s.
. In case of four coils, program any series of Open commands;
. Program a COC sequence.
. Execute a test that simulates the lack of Auxiliary Voltage.

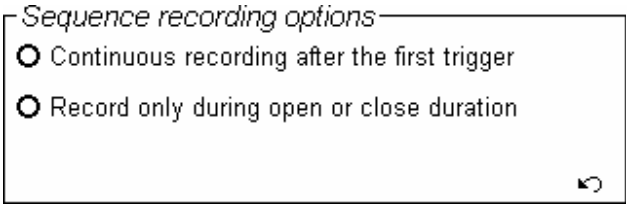
To this purpose, the following window is opened.



. Time delays and durations are independently set for each cycle; these values are independent with respect to those selected for the single test: see here after.

The user must take care of defining a proper sequence, in terms of timing and Open-Close sequence.
Add and Delete commands help editing the test sequence. The Delay selection must be set between two commands: remember that the CB cannot be driven with timings less than 30 s.

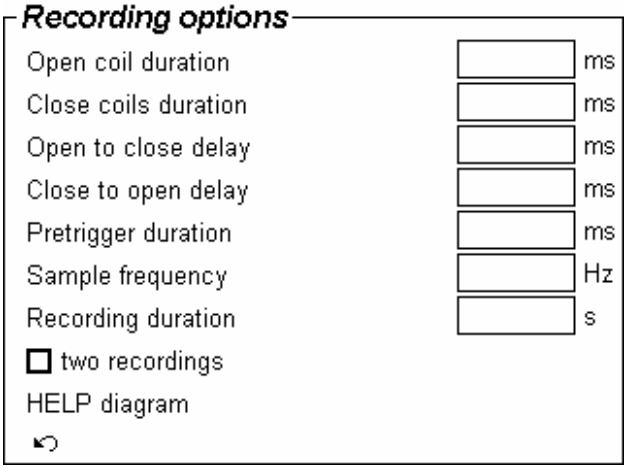
- The Recording Options command opens the following window.



. With the first selection, the recording is continuous, including the delay between tests. This selection is not to be used unless for short tests: the long delay reduces screen resolution and time measurement accuracy.
. With the second selection, the recording is performed at the highest resolution, around the Open or Close commands: this is to be selected in case of long sequences.

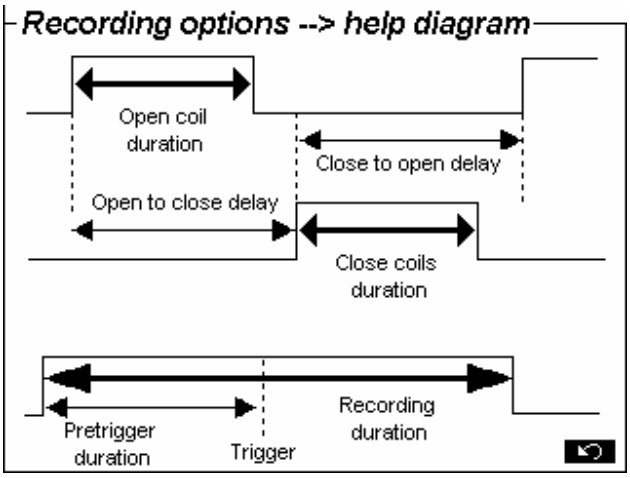
2.3.5.4 Recording options

This selection defines how test results will be recorded: pressing it, the following window is displayed.

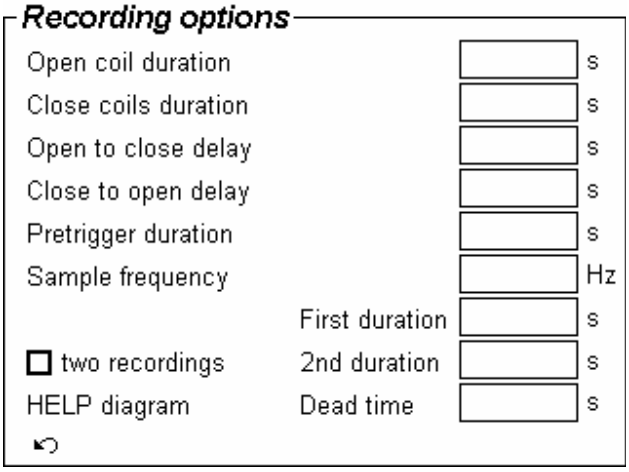


The timing definition can be displayed pressing “HELP diagram: the following window is displayed. As you see from timing definitions, it is possible to superimpose a Close command to the Open command: this is obtained setting the “Open to close delay “ smaller than the “Open coil duration”.

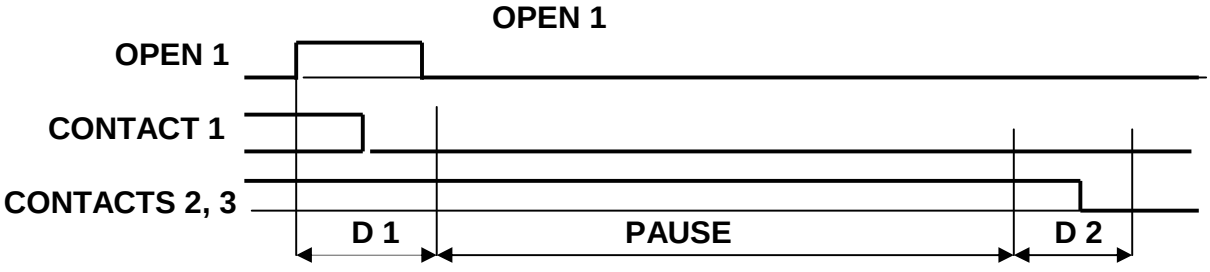
The “Pre-trigger” duration applies only to the beginning of the test (or sequence).
The “Recording duration” includes all delays: it must be bigger than “Pre-trigger” + “OC delay” + “CO delay” + the CB timings, so that no significant part of the test is lost. On the other side, it should not be too big, as it defines the test result dimension, hence the number of test results that can be kept in memory. Pressing HELP diagram, the following window explains the definition of terms.



. Two recordings selection. In this mode, the measurement is performed in two steps, separated by a pause: this avoids losing the timing resolution. It is possible to program a first recording duration, then a dead time, then the second recording duration. In this mode, coil currents and the analog input are not monitored. If the box is checked, the selection window changes as follows.

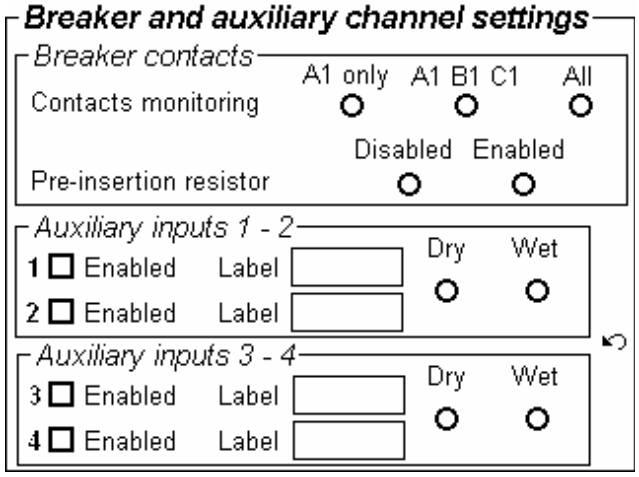


The following diagram explains timing definitions: it allows testing the action of the “pole discrepancy” protection.



2.3.5.5 Breaker and auxiliary channel settings

This selection defines the channels that will be monitored and recorded: pressing it, the following window is displayed.

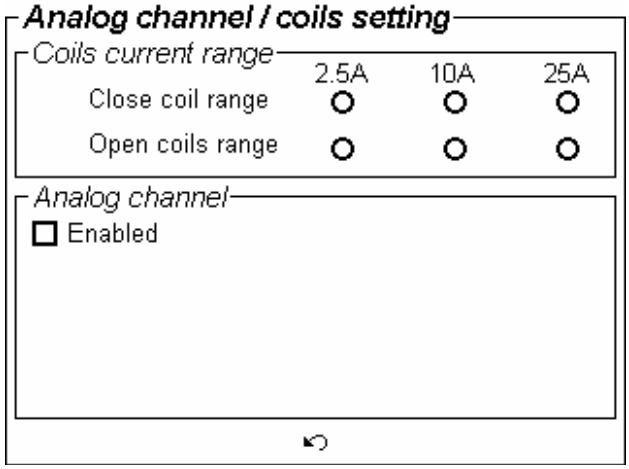


- In the first set of selections, related to CB contacts, it is possible to select which contacts should be monitored: "A1 only for preliminary tests; "A1 B1 C1" for single-chamber CB; "All" for 2-chamber CB. Besides, it is possible to select the pre-insertion resistor test.

- In the second and third set of selections, it is possible to enable the test of auxiliary inputs, to label them, and to select whether the contact is wet or dry: A1-A2 can be different with respect to A3-A4.

2.3.5.6 Analog channel / coils settings

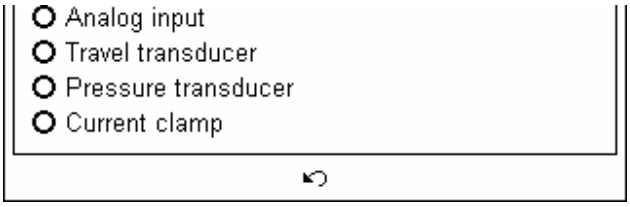
This selection defines the parameters of the analog channel and of the coil currents that will be monitored and recorded: pressing it, the following window is displayed.



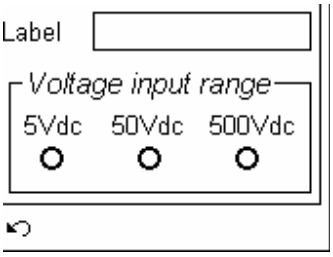
- The first set of selection allows for the separate definition of the Close and Open coils current ranges. The selected value must be greater than the nominal coil current, else the recording will be cut

(saturated) at the selected range value, and peak current measurement will be impossible. However, in case of wrong selection no damage to measurement circuits will occur.

For the Analog channel, if the box is checked the following lower part of the screen is displayed.



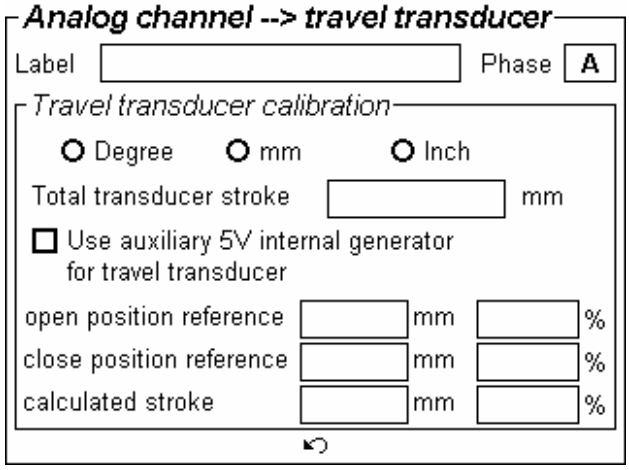
- The “analog input” selection means that the channel is connected to any other source than travel or pressure transducer: for instance, auxiliary voltage, or Motor voltage, or Motor current. With this selection, the following window is displayed.



It is possible to label the input, and to select the voltage range, that must be greater than the nominal coil current, else the recording will be cut (saturated) at the selected range value, and the actual measurement will be impossible. However, in case of wrong selection no damage to measurement circuits will occur.

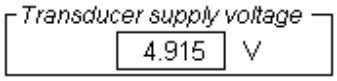
- The “Travel transducer” selection means that the channel is connected to a travel transducer, and that it is desired to convert the input voltage into: stroke, speed, acceleration. The program will take into account the fact that the beginning of the stroke is not 0 V, and that the end of the stroke is not the voltage that supplies the transducer.

With this selection, the following window is displayed.

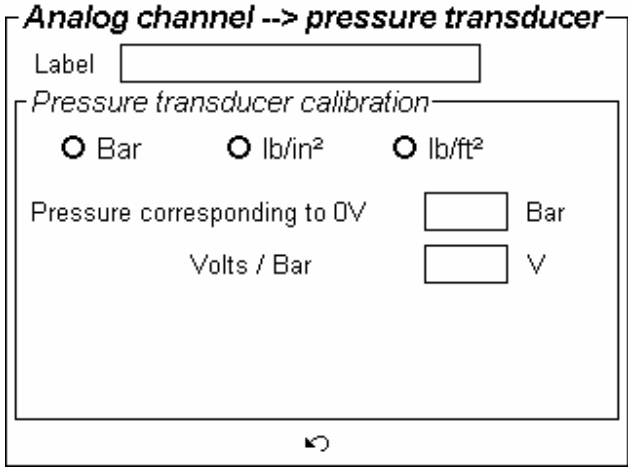


You can select the unit of measurement, and you have to key in the stroke corresponding to the maximum transducer movement; then, the program asks you to open (or close) the CB, and displays the open and close positions, and the corresponding stroke.

If you check the box “Use auxiliary 5 V generator for travel transducer, this means that you have connected the transducer to the 5 V output sockets  ; else, you have to input the external supply voltage value.

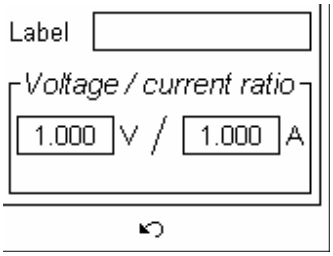


- The “Pressure transducer” selection means that the channel is connected to a pressure transducer, and that it is desired to convert the input voltage into pressure, taking into account the fact that at zero input voltage the pressure can be different from zero. With this selection, the following window is displayed.



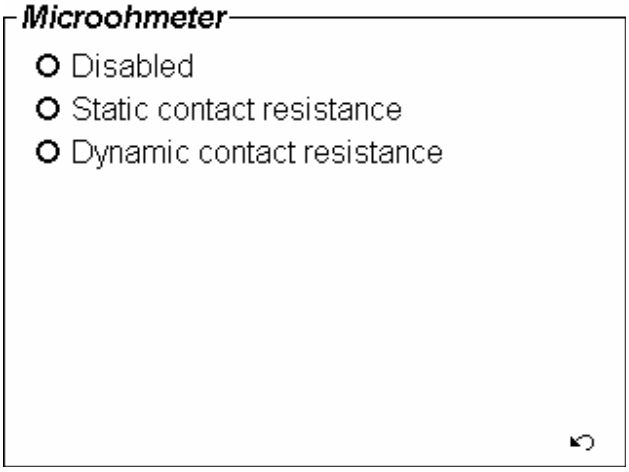
It is possible to label the transducer, to select the unit of measurement, to select the pressure at 0 V, and the V/pressure transducer constant. With these parameters, the screen will display the actual pressure.

- The “Current clamp” selection is for the measurement of current by means of a clip-on transformer, that outputs voltage with a coefficient that can be programmed in the following window.



2.3.5.7 Micro-Ohmmeter test

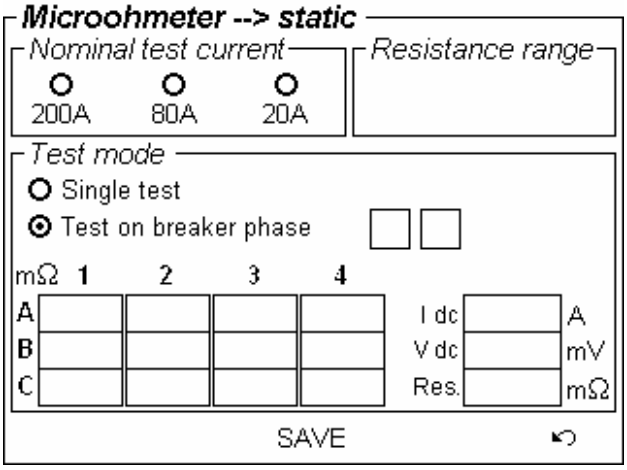
This selection can be accessed only if the option is available: pressing it, the following window is displayed.



The “Static resistance test” selection 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.

With the “Dynamic resistance test” selection 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 result is the resistance profile during close: the contact resistance value is less accurate than the measurement above, but the additional information is the actual behaviour of the contact as it closes.

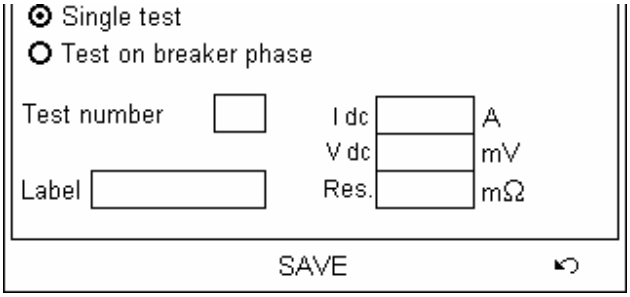
- With the “Static resistance test” selection, the following window is displayed.



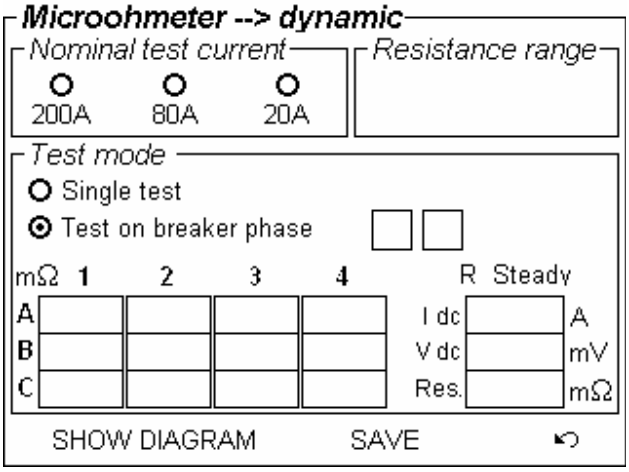
- The “Nominal test current” selection sets the test current and also the resistance measurement range: 200 A for the 1 mOhm range, 80A for the 10 mOhm range, 25 A for the 100 mOhm range. After the current selection, the corresponding resistance range is displayed.

- The “Test mode” selection allows to perform a single measurement, or to measure in sequence the resistance of all CB contacts. If the selection is “Test on breaker phase”, it is possible to specify the CB phase and contact under test; test results will be displayed in the summary table.

If the selection is “Single test”, the following window is displayed.



- With the “Dynamic resistance test” selection, the following window is displayed.



- As above, the “Nominal test current” selection sets the test current and also the resistance measurement range: 200 A for the 1 mOhm range, 80A for the 10 mOhm range, 25 A for the 100 mOhm range. After the current selection, the corresponding resistance range is displayed. Note that the 1 mOhm range is the typical one.

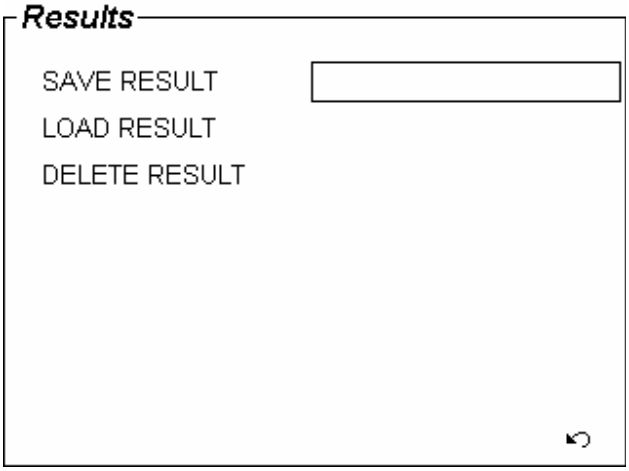
- As above, the “Test mode” selection allows to perform a single measurement, or to measure in sequence the resistance of all CB contacts. If the selection is “Test on breaker phase”, it is possible to specify the CB phase and contact under test; test results will be displayed in the summary table.

- The “show diagram” selection allows to watch the test result as a resistance vs. time diagram.

2.3.5.8 Results

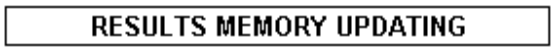
During the test, test results can be stored in the memory (up to 500 results may be stored). At the end of test, test results can be transmitted to a PC provided with TDMS. The software allows saving test results, examining them and so on.

This selection allows operating on test results: pressing it, the following window is displayed.

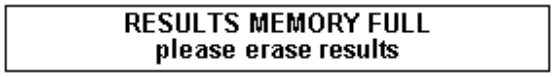


It is possible to: “Save” a result, defining the file name; to “Load” a result, selecting it on the test results list; to “Delete” a result, selecting it on the test results list. If, after a test, the result is not saved, and a next test is issued, a warning message is displayed.

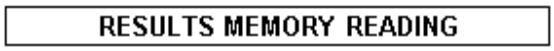
The file recording can take some time: in the meanwhile, the following message is displayed.



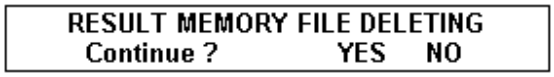
If the memory is full, the following message warns the operator. Usually, test results are deleted after downloading them into the PC.



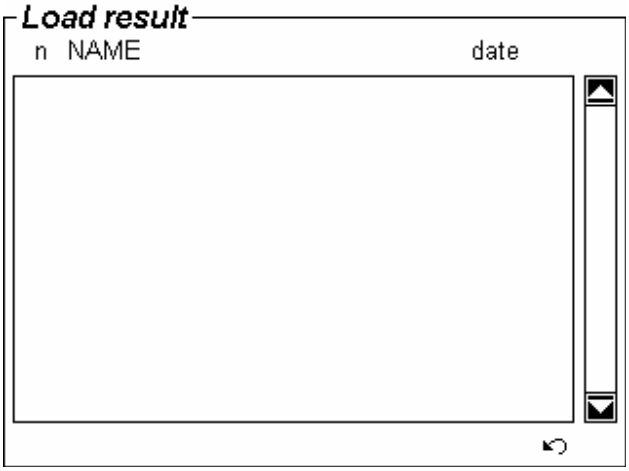
Also the file reading can take some time: in the meanwhile, the following message is displayed.



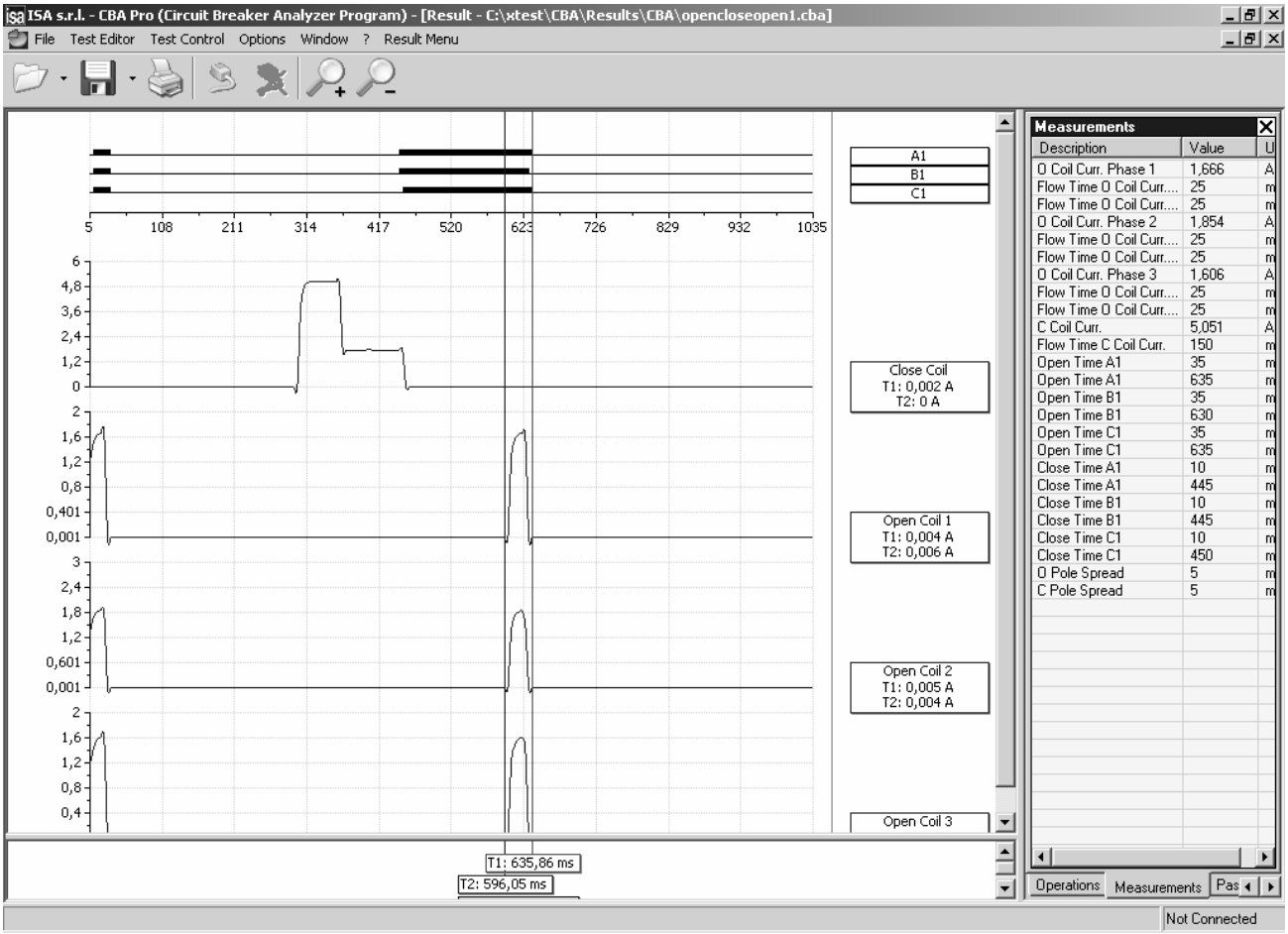
When you delete a result, the following message is displayed.



Files are selected by: the progressive number, the Name defined above, the Date of test. The window is the following.

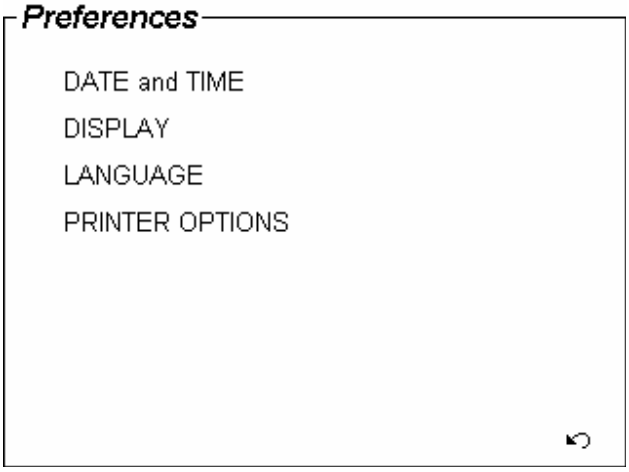


The following is an example of test result on the PC window.



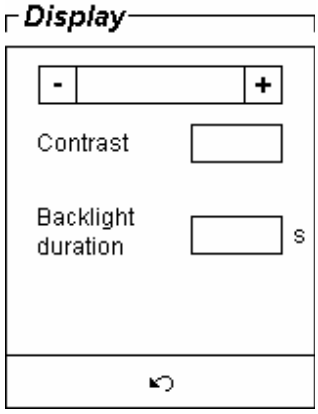
2.3.5.9 Preferences

This selection allows defining some ancillary selections: pressing it, the following window is displayed.



- Date and time can be set with the first selection; the following window is displayed.

- With the “Display” selection, the following window is opened.



. The contrast can be adjusted pressing on the + and – keys.

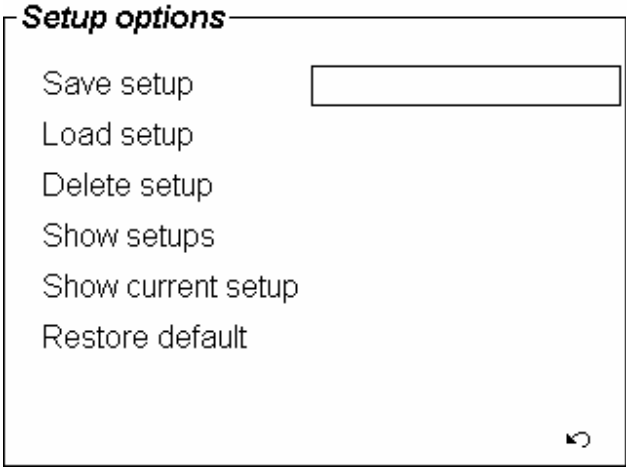
. The backlight duration selection is provided for the case of battery operation, as the backlight sinks an important amount of power.

- With the “Language” selection, the following window is opened.

More languages will be available with further releases.

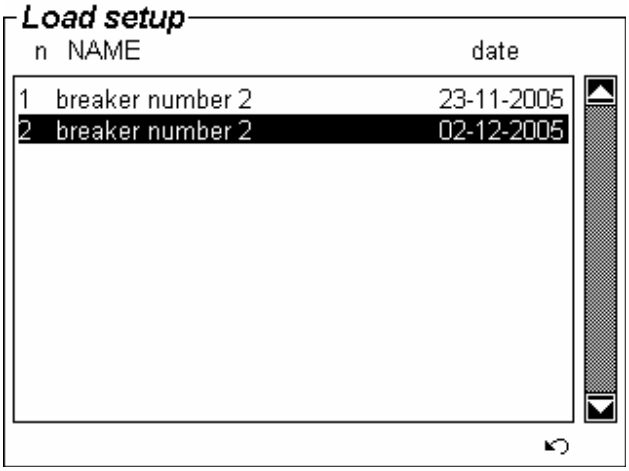
2.3.5.10 Set-up options

This selection allows operating on test set-up: pressing it, the following window is displayed.



- With “Save setup” it is possible to give a name to the current settings, and to save it into memory. Any setting can be saved to and recalled from the memory. Up to 64 settings can be stored and recalled. Settings are permanently stored in the memory; new settings can be written to the same address after confirmation.

- After “Load setup” and “Delete setup”, the list of set-up is displayed.



The file recording can take some time: in the meanwhile, the following message is displayed.

If the memory is full, the following message warns the operator.

SETUPS MEMORY FULL
please erase setups

Also the file reading can take some time: in the meanwhile, the following message is displayed.

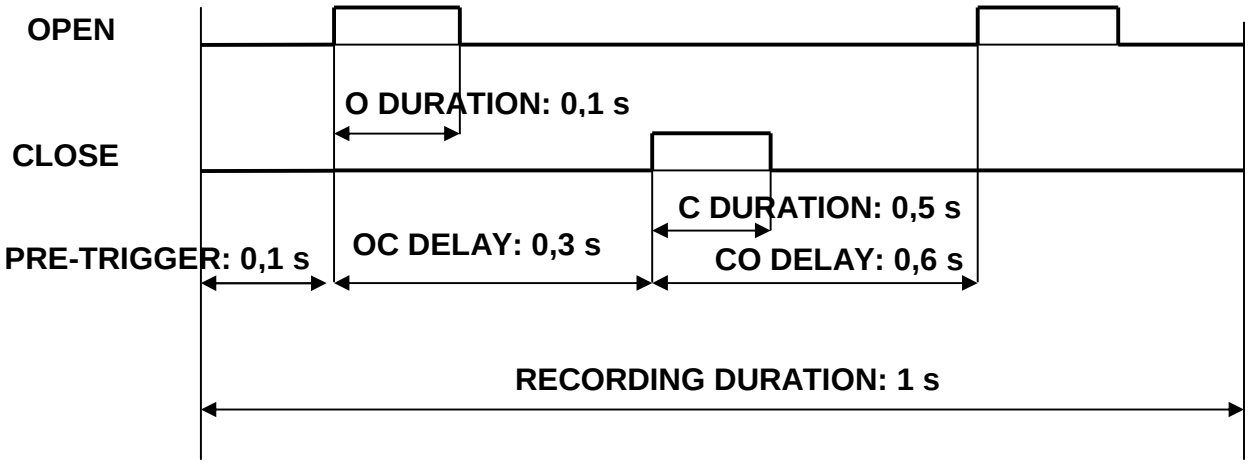
SETUPS MEMORY READING

- After “Show setup” and “Show current setup”, all selections are displayed; this helps avoiding to go through all selection windows.

- Last selection, “Restore default”, restores the default selections, that are the followings. For normal mode operation it is possible to recall the default setting, that cannot be modified. This setting is loaded at power-on.
- Trigger options: internal trigger.
- Test option: Open-Close-Open.
- Recording options:
. O-C delay: 0.3 s;
. C-O delay: 0.3 s;
. O command duration: 0.1 s;
. C command duration: 0.1 s;
. Pre-trigger duration: 0 s;
. Sample frequency: 1 kHz;
. Recording duration: 1 s;
. Two recordings: disabled.
- CB settings:
. CB contacts enabled: A1 + B1 + C1;
. Pre-insertion resistor test: disabled.
. Auxiliary inputs: disabled.
- Coils settings:
. Open coil: 10 A;
. Close coil: 10 A.
- Analog input: disabled.
- Micro-Ohmmeter: disabled.

- Results: Save.

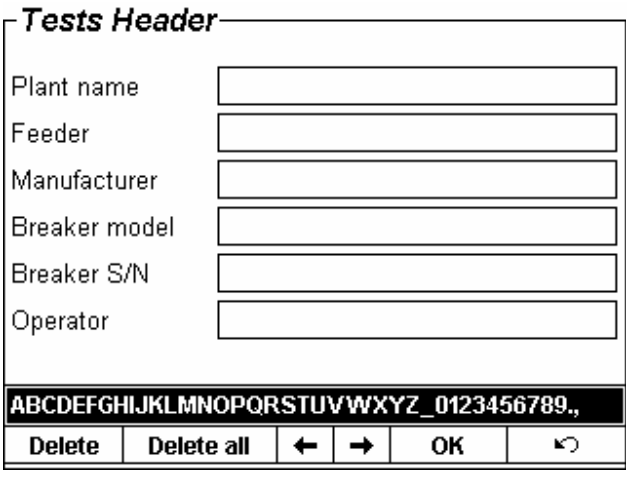
The default timing is shown below.



If these values match with what you want to do, you can immediately start the test; else, you can load a previously saved setting, or you can enter the menu, modify the desired parameters and then save the setting, before proceeding.

2.3.5.11 Tests header

This selection allows setting the header of a single test or of all tests performed on the CB: time measurement, contact resistances.. Pressing it, the following window is displayed.



Data can be keyed on as follows:
. Using the keypad: rules are the same as portable phones;
. Using the knob to select the digit on last line.

Pressing OK after edit, all next tests will be assigned the same header, until it is modified.

2.3.6 Magnifying lenses

Pressing these lenses, the area between the cursors is enlarged or reduced. This allows magnifying the part of interest of the diagram.

2.3.7 t1, t2, dt

If t1 and t2 are selected, after the test the values of t1 and t2, corresponding to cursors 1 and 2, are displayed, along with the delay between them. To move the cursors, select t1 or t2 and press the knob: while t1 or t2 is shown reversed, moving the knob you can move the corresponding cursor, close to the position of interest.

2.3.8 Printer

Selecting the printer, the test set verifies if the optional thermal printer is available: if it is, the printout is performed on it, else the print message is sent to the selected interface. The following window allows selecting: All data; Header; Trigger options; Breaker options; Analog settings; Recorder options; Channel Set; Diagram; Time results table; Movement result table.

2.3.8 Left column

The left column is modified according to the View selections. The “Armed” selection means that the test set is ready, and that it will start measuring as soon as the trigger will be sensed on the SLAVE input socket.

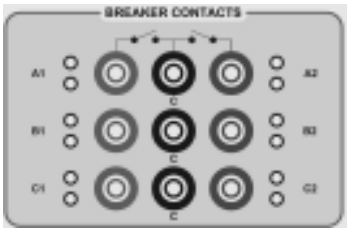
2.4 CB CONNECTIONS

2.4.1 Main CB contacts.

The first operation is to connect CBA1000 to main CB contacts. To this purpose, are provided six sockets in all, marked A1, B1, C1, and A2, B2, C2. The first ones are used for one-chamber CB; the others are used for two-chamber CB.

For the test of the pre-insertion resistor there is no further connection.

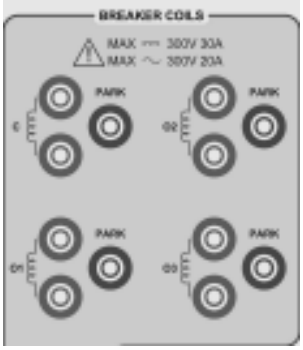
LED’s by the side are two: RED (above) if the contact is OPEN, and GREEN (below) if it is closed. The pre-insertion resistor is sensed as Open.



With optional connection cables, these inputs are connected to the CB by means of three 3-way cables, with different colors, each marked A, B, C.

2.4.2 Coil drivers

Next operation is to connect CBA1000 coil driver outputs to the CB coils.

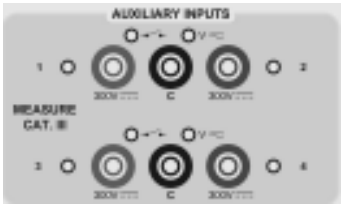


There are four groups, marked: C (Close coil); O1 (Open coil, or phase A Open coil, with four coil option); O2 and O3 (if the option is available; else, not connected). One side of the coil driver shall be connected to the auxiliary voltage positive (negative); the other to the coil. PARK sockets are not connected: cables to coils can be parked, until everything is checked.

With optional connection cables, these outputs are connected to the CB by means of four 2-way cables.

2.4.3 Auxiliary CB contacts.

Next operation is to connect logic CBA1000 inputs to the auxiliary CB contacts, if desired.



There are four inputs in all, divided in two ISOLATED groups of two inputs each. This serves for the case that a contact is with voltage, while the other one is not.

With optional connection cables, these inputs are connected to the CB by means of two 3-way cables, with bananas having different colors.

2.4.4 Travel transducer or analog input.

The travel transducer is a potentiometer; the cursor position corresponds to the pole position during the movement. There are two sockets with a protected + 5 V output that serves to polarize the transducer; the cursor is connected to the input. Else, it is possible to connect the input to any voltage that is desired to monitor during the test.

2.4.5 Micro-Ohmmeter.

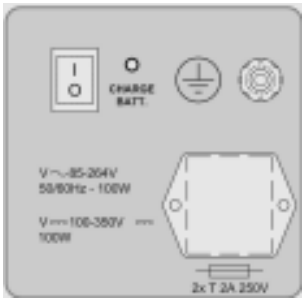
The test of the contact resistance is performed connecting the test object (CB contact, joint,...) to the high current sockets, and the voltage drop to the voltage meter input.

2.5 POWER-ON

CBA1000 can be operated in connection to a supply, or with the internal battery.

If you press the ON switch, the internal battery supplies CBA1000. The CHARGE BATTERY LED will turn on when the battery needs to be charged: this will occur shortly after the battery has been used. When the residual operation is about 30 minutes, the BATTERY LOW alarm will be displayed.

If you fit the mains into the plug, the CHARGE BATT. LED will turn on if and until the battery is to be charged.



When powered by the battery, consider that the battery operating time is 4 hours (CB tests), and 1 hour (micro-Ohmmeter tests). Battery charging time: 8 hours.

Power-on CBA1000: the introduction window is displayed, and a diagnostic sequence controls:
. Key microprocessor board components;
. Auxiliary supply voltages.
During this test, all LED's on the front will turn ON: if some does not, it is faulty.

If something is wrong, the operator is alerted by a message. At the end of it, default selections are active; CBA1000 displays the first window explained in the MENU paragraph.

At power-on, the following control lights turn on (default situation):
. SEL: O-C-O;
. Breaker contacts: they should be red before connection to the CB; green after the connection.

2.6 CONNECTION TO THE PC

CBA1000 can be connected to the PC via the RS232 or the USB interface; connection cables are provided.

The choice is performed on the software. If USB is used. The LED below it should turn ON as CBA1000 is connected to the PC.

Further operations are described in the software user's manual.

3 THE HELL, IT DOESN'T WORK

3.1 INTRODUCTION

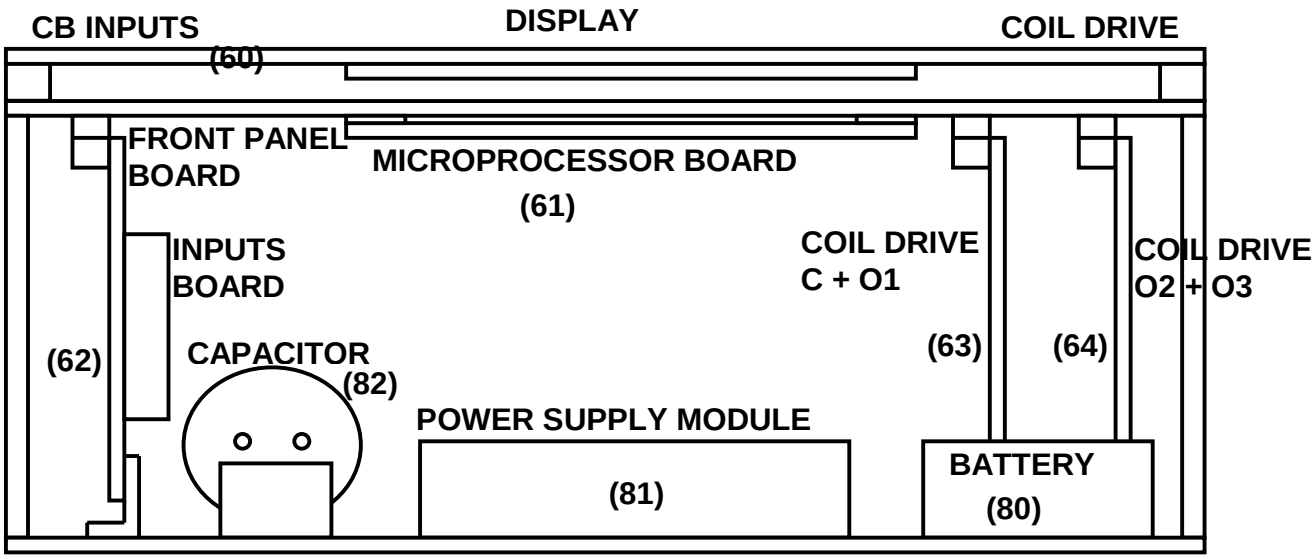
Sometimes, when my ears whistle, I wonder if it is because of some of my customers being angry at us because the test set doesn't work: according to Murphy's law, when it was most necessary. We at ISA do our best efforts to filter the so-called infant mortality of electronic components prior to delivery of all our test sets; and this after extensive testing of prototypes and pre-production units.

Yet, sometimes faults occur, because everything dies, including electronic components; so, please, before shooting at us, see if the following instructions can serve you to fix the problem. If not, e-mail us the problem, **not forgetting to mention the unit's serial number**: our business is to minimize your downtime. My e-mail address is:
primo.lodi@isatest.com

Last, our experience is that our test sets withstand very heavy duty cycles for long wiles, if correctly used; most problems arise because of:
. Lack of grounding in the mains supply;
. Severe spikes on the mains supply (spikes are not always so kind to respect standard limits): in case of doubt, use the internal battery;
. Transit, with the associated drops and thermal cycling;
. Errors, such as the connection to live wires.
Please mention in your e-mail how did the fault occur: this serves us for our continuous improvement program.

3.2 PHYSICAL DESCRIPTION

CBA1000 components are accessed by removing all screws on the bottom, and also the four screws on the feet, and lifting the central part by the handles. There is a main board mounted on the front panel, and a number of components mounted on the back panel. The arrangement, seen from the front, is shown in the figure below.



The optional micro-Ohmmeter auxiliary board (65) is located after the microprocessor board.

The microprocessor board (61) and the optional micro-Ohmmeter auxiliary board (65) are connected to the front panel board (60) and screwed to it. Other cards are kept in place by means of L-shaped supports, and are screwed unto them.

If a board is failing, it is necessary to remove the screws: then it can be lowered and removed.

3.3 ERROR MESSAGES

The test set performs a number of tests at power-on and during the generation. The following table lists all the messages, and the corrective action.

ERROR MESSAGE	CONSEQUENCE	CORRECTIVE ACTION
Diagnostic error, NVM-1 access	The test set cannot operate	The microprocessor board (61) should be replaced
Diagnostic error, NVM-2 access	The test set cannot operate	The microprocessor board (61) should be replaced
Diagnostic error, I2C – bus driver communication line access	No communication with the PC	The microprocessor board (61) should be replaced
Diagnostic error, Dual port memory access	The test set cannot operate	The microprocessor board (61) should be replaced

3.4 TROUBLE SHOOTING

The following table lists main faults, cause of fault and the corrective action.

SYMPTOM	POSSIBLE CAUSE	CORRECTIVE ACTION
Problems after transport	Heavy shock	Open CBA1000 and check for loose boards or connections.
At power-on does not turn on	Mains supply fuse open	Check the fuse; for other problems, see 3.4.1
The diagnostic is not completed: the test set is locked	Fault on the DC to DC converter	See 3.4.2
The control knob does not operate	Knob is not locked, or fault in the encoder	See 3.4.3
A coil driver does not close	Fault in the COILS board (63)	See 3.4.4
A breaker contact is not detected	Fault in the INTE board (62)	See 3.4.5
An auxiliary contact is not detected	Fault in the INTE board (62)	See 3.4.6
The travel transducer does not operate	Fault of fuse (20)	See 3.4.7
The micro-Ohmmeter does not operate	Fault in the board (63)	See 3.4.8
Problems during upgrade	Loss of supply during upgrade	See 3.4.9
The fault cannot be fixed	-	See 3.4.10

3.4.1 No power at power-on

The mains fuse is located in the power supply plug, in the small drawer. Check it; if it is broken, replace it.

As an alternative, the battery could be causing the problem. To verify this, act as follows:

. Open CBA1000;
. There are four wires from the battery (80), connected to two connectors going to the front-panel board (60): remove the connectors and power-on again.
. If the test set is now operating, the battery (80) should be dismounted and replaced.
. If the test set is not yet powering-on, power-off and disconnect the four-way connector from the power supply module (81) to the front-panel board (60); then power-on and measure the following voltages, taking the black wire as the reference:
. Red wire: + 5 V;
. Brown wire: 12 V;
. White wire: 21 V.

If any of these voltages is missing, in particular the + 12 V, the test set cannot operate: the auxiliary power supply module (81) should be dismounted and replaced.

If voltages are OK, but no power-on, the test set needs to be returned.

3.4.2 The test set is locked up

In this situation, the fault is likely to be located in the MICR board (61). The removal is performed unscrewing the four screws: there are two connectors on both edges. Fit the replacement one, and verify: if the test set is OK you can continue; else, the test set needs to be returned.

3.4.3 The control knob does not operate

First of all, check that the knob is blocked on the encoder shaft. To this purpose, remove the plastic cap in front of the wheel: you get access to the locking nut. Check that it is tight; else, put a piece of paper below the knob, in order to create a gap between knob and front panel, and tighten the nut; then, set back the plastic cap.

If the encoder is broken, it is possible to remove it with the following steps:
. Remove the MICR board, unscrewing the four screws;
. Disconnect the flat cable;
. Remove the knob and unscrew the encoder: it can be withdrawn.

Fit the replacement one, and verify: if the test set is OK you can continue; else, the test set needs to be returned.

3.4.4 A coil driver doesn’t close

In this instance, the fault is likely to be located on the corresponding coil driver board, PWA11428: to the left, the board for C and O1; to the right, the board for O2 and O3.
. Remove CBA1000 from the container.
. Locate the faulty board, (63) OR (64).
. Remove it, by unscrewing the two screws to the L-shaped support.

. If the fault is on the board C + O1, and the second board is available, set the second board at the place of the first one: CBA1000 can be operated in three phase Open mode, until the replacement board is available.

If the fault is not recovered by the replacement board, the test set needs to be returned.

3.4.5 A breaker contact is not detected

First of all, verify that LED's are red; then, short-circuit each pair, and verify that the corresponding LED turns green.

If some CB input does not behave correctly, verify that on that socket pair there is a voltage of about 24 V DC, between the central black socket and the socket to be tested.

If this is not true, the fault is located in the INTE board (62), PWA11429: remove it, by unscrewing the five screws to the L-shaped support, and replace it with the new one. In the meanwhile, you can continue operating with CBA1000, selecting ALL CB inputs, and performing the tests one chamber at a time, avoiding to connect to non operational inputs.

If the recording is correct and the LED does not turn on, then there is a faulty LED: for the repair, the test set needs to be returned.

If there is a doubt about the timing metered by CBA1000, please press the Set pushbutton, and select the default setting: this avoids that some exotic timing is the cause of the problem.

3.4.6 An auxiliary contact is not detected

First of all, verify that LED's are red; then, short-circuit each pair, and verify that the corresponding LED turns green.

If some auxiliary input does not behave correctly, verify that on that socket pair there is a voltage of about 14 V DC, between the central black socket and the socket to be tested.

If this is not true, the fault is located in the INTE board (62), PWA11429: remove it, by unscrewing the five screws to the L-shaped support, and replace it with the new one. In the meanwhile, you can continue operating with CBA1000, using other auxiliary contacts.

If the recording is correct and the LED does not turn on, then there is a faulty LED: for the repair, the test set needs to be returned.

If there is a doubt about the timing metered by CBA1000, please press the Set pushbutton, and select the default setting: this avoids that some exotic timing is the cause of the problem.

3.4.7 The travel transducer does not operate

First of all, verify that there are 5 V between sockets (18); if not, check for fuse (20): if it is open, replace it.

If the fuse is OK or if the + 5 V is not there, use an external voltage and connect it to input (17). Start a test and verify: if the voltage is measured, then the problem is on the + 5 V supply. In this instance, the fault is located on the Front-Panel board (60), PWA11430: it is necessary to return the test set. Also if the measurement is not performed, the test set should be returned for repair.

3.4.8 The micro-Ohmmeter does not operate

The micro-Ohmmeter operation is controlled by board (65); the power comes from the big capacitor (82). To replace the board, act as follows:
. First of all, VERIFY THAT THE CAPACITOR IS COMPLETELY DESCHARGED: given the big capacitance value, it takes a long time to dissipate its energy. The operating voltage is 10 V; if it is not completely discharged, use a 100 Ohm 10 W resistor. **DO NOT DISCGARGE BY SHORT-CIRCUITING LEADS: THIS COULD EVEN MAKE THE CAPACITOR TO EXPLODE!**
. Next, remove the board (65), and replace it.

3.4.9 Problems during upgrade

The firmware upgrade is performed via software. When the file is transferred into CBA1000, the following message is displayed.

When the file has been transferred, the firmware upgrading is performed: this is displayed by the message:

When the message disappears, the update is completed, and the test set can be operated.

If during the Upgrade operation the power went off, and the test set is no more operational, to recover the situation proceed as follows. At power-on, keep the START button pressed until the diagnostic is finished, then release it. The test set goes to an “HW DEBUG” mode, and it accepts the downloading.

3.4.10 The fault cannot be fixed

If the fault is too hard to be fixed, you have to deliver CBA1000 back to your agent. We have encountered problems caused by a poor packing of instruments that have been delivered us for calibration or repair. In order to avoid such inconveniences, please apply the following procedure.

First of all, compile the following form, and attach it to the instrument. **Please do not forget to compile it**.

With the instrument should come the mains supply cable, and the interface cables. The user's manual originally delivered with the test set is not necessary.
Cover the instrument with a polyester film, in order to protect it against dust and foam.
The instrument should be protected by anti-shock foam having a minimum thickness of 5 cm ON ALL SIDES.
Use a new carton box as a container. On the box apply the UP and the FRAGILE labels.
In the box the instrument will be placed horizontal or standing; not upside down.
Last but not least, do not declare an high value for customs: this expedites clearance of the good and lowers fees.

INSTRUMENT RETURN FORM

DATE _____ AGENT _____ COUNTRY _____

TYPE OF INSTRUMENT _____ SERIAL NO. _____

INSTRUMENT RETURNED FOR: CALIBRATION ____ REPAIR ____

In case of repair, please specify the following.

DATE OF FAULT _____ REPORTED BY E-MAIL, PHONE _____

COMPANY _____ USER'S REFERENCE _____

FAULT DESCRIPTION _____

_____
_____
_____
_____
_____
_____
_____
_____

HOW DID IT OCCUR _____

_____
_____
_____
_____
_____

LOCAL ANALYSIS OR ATTEMPTS TO REPAIR _____

_____
_____
_____
_____
_____

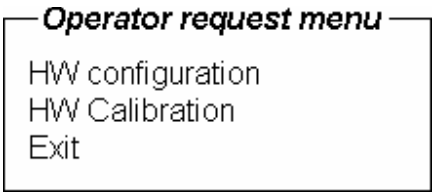
RECOMMANDATIONS AND NOTES _____

_____
_____
_____
_____

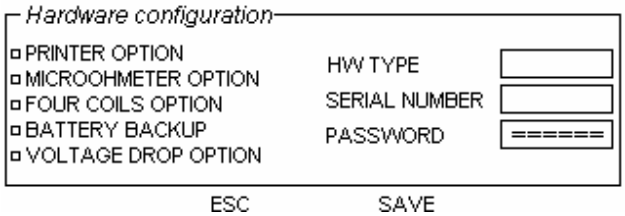
3.5 ADDING OPTIONS

It is possible to add options after the test set has been delivered; they are: four coil drive; internal printer or voltage drop.

In this case, when you receive the option, first of all install it into the test set; then, power-on keeping the START button pressed until the diagnostic test starts. At the end of diagnostic, the following window is opened.



Selecting HW configuration, the following window is opened.



It is necessary to check the added option, so that the microprocessor learns that it has been installed, and takes control of it.

With this selection, you can also input your password, that is blank at the beginning. After this, the first message after power-on is “Input the password”. Take care, because if you lose it, it is hard to recover the operation.

3.6 CALIBRATION

3.6.1 Introduction

With the same operation as above, you can enter the Calibration mode.

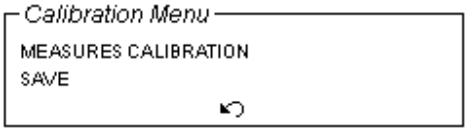
CBA1000 does not need to be calibrated, as metering circuits employ high stability components.

It is suggested to check the unit every 3 years, by comparing CBA1000 measurements to external meters. Tests should be performed with an **accurate multi-meter**, that should guarantee a maximum DC measurement error of 0.1%, both for voltage and current, and some **high current sample shunts**, for the micro-Ohmmeter test. The adoption of lower-class instruments may cause false interventions, that introduce errors into the test set.

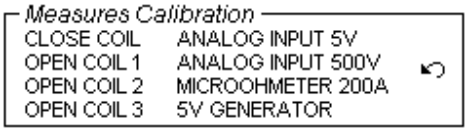
At the end of the test, if deviations are not acceptable it is possible to enter the calibration mode, and correct for deviations.

3.6.2 Calibration procedure

The first window is the following.

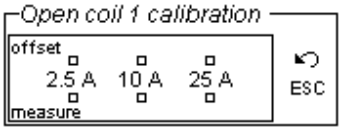


Once “Measures calibration” has been selected, the following window is opened.

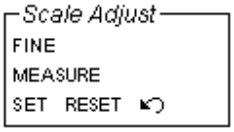


You can select the channel to be calibrated.

- If it is a coil current measurement, the following window is opened.



It is possible to calibrate both the offset and the measure. For the offset, put a jumper on the coil driver, then select the offset channel: the following window is displayed.

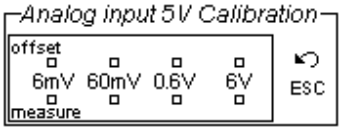


If you check Fine, the offset is automatically adjusted; press Set to save the new correction.

For the amplitude, you need an external, stable current source, such as that generated by a relay test set. Press Measure and then apply the full range current: the window displays the current measurement; you can adjust the reading by the knob, until it matches the applied current.

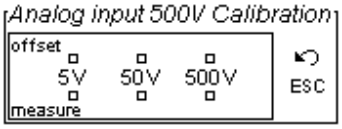
NOTE: in the 25 A range the calibration is performed at 10 A, in order to avoid over-heating the measurement shunt. Press Set to acquire the calibration.

- If the 5 V input is to be calibrated, the following window is displayed.



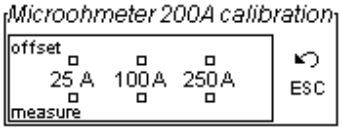
The offset calibration is executed as above, short-circuiting the input. For the amplitude, you need an external, stable voltage source, such as that generated by a relay test set. Press Measure and then apply voltages, as displayed; then, set the measurement.

- If the 500 V input is to be calibrated, the following window is displayed.



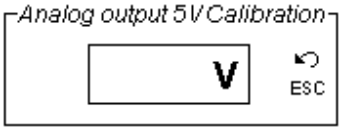
The offset calibration is executed as above, short-circuiting the input. For the amplitude, you need an external, stable voltage source, such as that generated by a relay test set. Press Measure and then apply voltages, as displayed; then, set the measurement.

- If the micro-Ohmmeter is to be calibrated, the following window is displayed.



The offset calibration is executed as above, short-circuiting the output. For the amplitude, you need three accurate, high current shunts, rated: 25 A, 100 mOhm; 100 A, 10 mOhm; 250 A, 1 mOhm. Press Measure; then, set the measurement.

- If the 5 V output is to be calibrated, the following window is displayed.



You need a voltage meter: connect it to sockets (18), then modify the reading so that it matches with your meter.

At the end of the session, the following window is displayed.: all parameters are saved in the non volatile FLASH EPROM.

APPENDIX 1: SPARE PARTS LIST

The following is the suggested list of spare parts for a duration of five years and for up to five test sets. The reference is made to the list of components.

1) N. 10 Fuses in the supply socket (1), rated T5A, code XFU.
2) N. 10 Fuses of the 5 V DC voltage (20), rated F100mA, code XFU.
3) N. 1 Encoder with switch, for MENU control knob (5), code XCM10160.
4) N. 1 Printed circuit board INTE (62), code PWA11429.
5) N. 1 CB coils driver board (63), code YWA11428.
6) N. 1 Battery (80), code .
7) N. 1 Auxiliary supply voltages module (81), code .
8) If the option is present: N. 1 Micro-Ohmmeter board (65), code PWA11432.

APPENDIX 2: TEST SET SCHEMATIC