Circuit Breaker Test System

Software Version 12.2

User manual

Produced by

TAPCO Company

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Contents

Chapter1- General features

Characteristics

- Getting breaker specifications from user and storing
- Automatic gathering and storing some breaker information such as motion curve, coil current curve, motor current curve, minimum voltage of coil operation, under voltage relay, anti pumping relay and blocking coil current
- Magnifying motion curve and ability to display two maneuvers simultaneously from one breaker or two different breakers
- Calculating speed of close and open maneuvers and coil current in each point of motion curve pointing by mouse
- Calculating contacts movement, contacts speed, overtravel, rebounce, safety limits, contacts operation time, maximum coil and motor current, charging spring time and …
- Display linear and rotary sensors status, contacts status (close or open), voltage measure, power supply output current
- Indicating test parameters like sampling duration time, time of applying voltage to coils and … according to breaker type
- Ability to show permitted limits for breaker parameters such as speed and operation time of close and open maneuvers, surveying them and showing the result in a table after doing each close or open maneuvers
- Full bilanguage: English and Persian

Task

General task of **circuit breaker test system** is gathering and storing test results of breaker so that quality of breaker functions is chosen according to that information. Some of this information is entering by user as following:

- Basic information of breaker regarding to its tag such as serial number, type, nominal voltages of electrical equipments and …
- Resistance of electrical equipments and poles
- Test result of electrical equipments and poles
- Control result of primary relay, over current relay, wiring and …
- Test result of leakage
- Gas pressure of poles
- Serial numbers of primary relays

For storing this information there are suitable forms available for user.

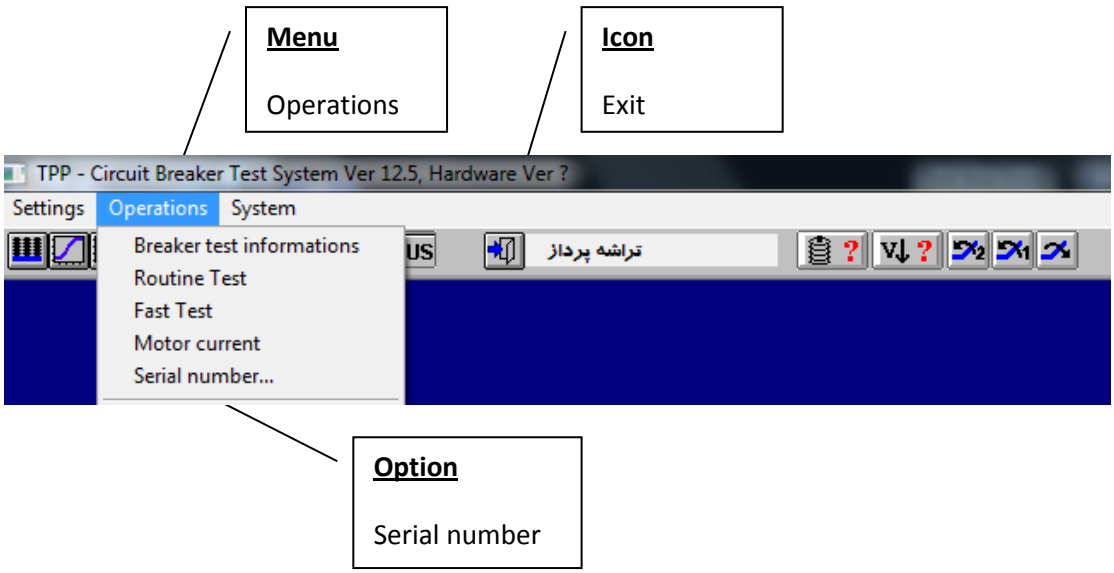
Some other information is gathered and stored by system automatically as following:

- Contacts motion curve, coil and motor current curve
- Contacts operation and duration time, out of sync of contacts
- Anti pumping relay test
- Calculating minimum voltage of coils operation
- Testing of under voltage relay
- Calculating blocking coil current
- Calculating maximum and minimum safety limits

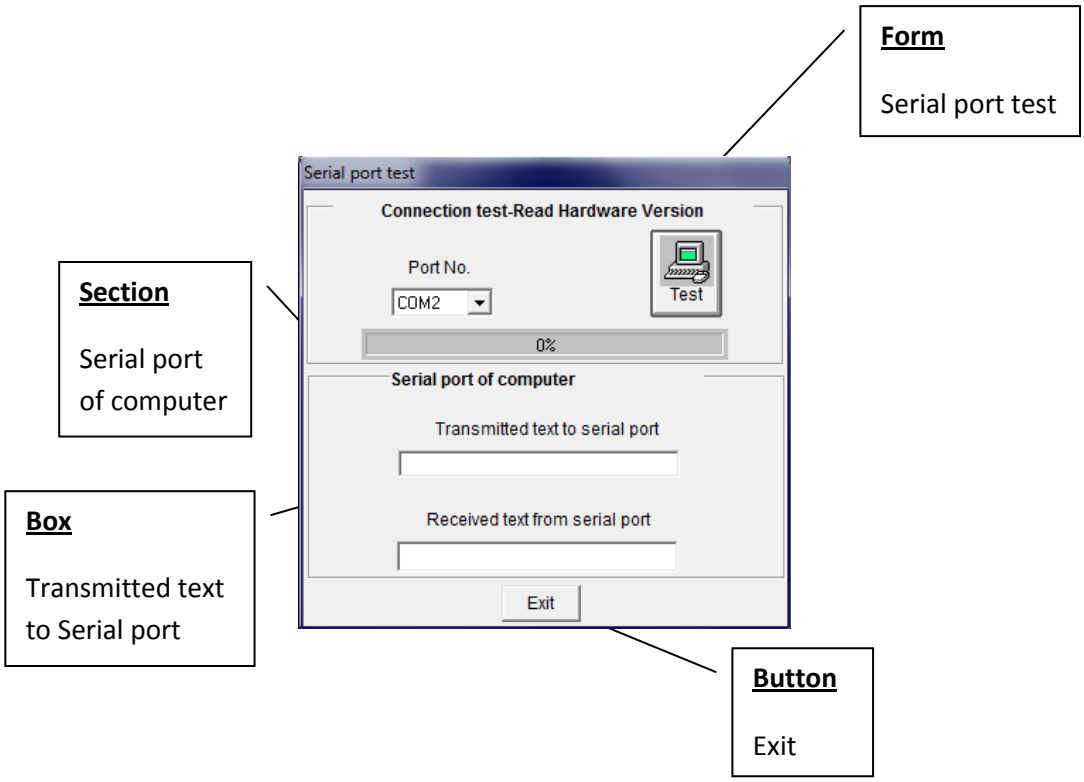
To store this breaker information, required and suitable functions are done by system (program and tester) and results are shown. During these operations, program displays suitable messages for user and surely during each operation user can stop the operation.

Terminologies and alternatives

Icon, Menu, Option:



Form, Button, Section, Box:



Chapter2- Installation and files definition

You can find file ***setup.exe*** on CD. Run it and continue regarding appeared messages.

ⓘProgram under windows 98 and higher is installable.

ⓘIf install folder exist clear files in it.

ⓘAlways prepare a copy of install CD.

After finishing installation, the following files should be in install folder:

Breaker.mdb	Mitr__sf.ttf	Trafb_sf.ttf
Breakqc.exe	Mitrb_sf.ttf	
Form_cod.bmp	Qmitrabs.ttf	
Iso_logo.bmp	Qmitras.ttf	
Psw_logo.bmp	Sinsb_sf.ttf	
Psw_lat.bmp	Traf__sf.ttf	

Breaker.mdb

It is main database to store breaker information and other settings of program. The name of this database is fixed and unchangeable. If it doesn't exist in installed folder, program can not be executed.

ⓘif you want to install program again, to prevent rewriting database, first copy database in another place then after finishing installation, recopy it in install folder (overwrite). Therefore, test results of breakers, permitted limits of parameters, displayed titles on forms and all setting will be available so that don't need to set parameters again after reinstallation.

Breakqc.exe

This is main executable file of program.

Form_cod.bmp

This file contains number that appears at the bottom of printed reports (form number).

Iso_logo.bmp

It contains logo of ISO 9002 that is printed in reports.

Psw_logo.bmp

It contains logo of company containing Persian titles which this program has been licensed for it. It is printed in reports.

Psw_lat.bmp

It contains logo of company containing English titles which this program has been licensed for it. It is printed in reports.

*ⓘBy modifying these **.bmp** files, you can change appeared titles and logos in program while printing and displaying.*

Files with .ttf extension

Actually, they are used fonts files in program. If these fonts don't exist in windows, you can install them via control panel.

After executing program, following files will be produced:

Sampler.ini

It contains last settings in form ***Constants setting*** and ***calibration coefficients*** and some other settings.

ⓘIt is strongly recommended not to manipulate this file directly and do desired changes via program.

ⓘIf software has been installed before and you are going to install it again, to prevent rewriting this file, firstly copy this file in other place and after installation, recopy it in install folder (overwrite). Consequently, basic information settings and calibration coefficients and … will be available again and you don't need set them again.

Empty.mdb

This is an empty database for creating backup database.

Used fonts

Following fonts are used and you have to install them:

Times New Roman, Mitra, Mitra-s: To print curves

Traffic, Arial: Titles appeared in program forms

*ⓘFonts appeared in program forms are changeable in menu **Setting** option **Basic Information***

Chapter 3- Execution

Circuit breaker test program is also run like other under windows software. At the first run (or if ***Sampler.ini*** wasn't in installed folder) a message will come up that shows this file not found. By running program, this file will be created by default values and in program these default values also are used. So, some problems may be arisen. For example in serial port, and messages like ***Serial port not available*** or ***Communication error*** may be shown. Therefore, after running program (first time), all settings should be reviewed in form ***Constants setting***.

ⓘIf your windows is not supported by Persian language or it can't show Persian fonts correctly, you can set program interface to English language by pressing icon US *or writing* ***English*** *in front of "****Language=****" phrase in* ***Sampler.ini*** *file.*

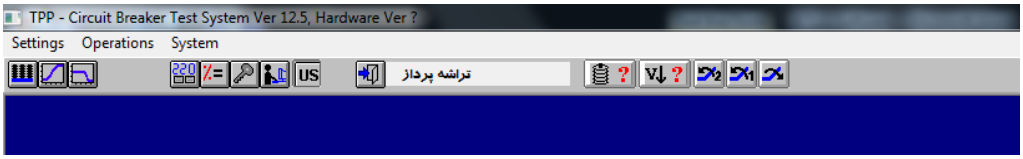
Form ***Connection…*** is always appeared in start of program execution. You can stop it by pressing ESC key or closing it.

Correct password should be entered whenever running program. Consequently, each user has his own code as a signature. Before running program it's better to turn tester on. Otherwise, additionally to the error message ***no connection*** at the first of running program, ***power supply*** form and ***Sensors and Contactors*** form never be open and active.

ⓘIn case of changing tester while program is running, it's better to run program again.

Main form of program

The main form of program is appeared as below:



All program capabilities are available by selecting desired option from proper menu or clicking proper icon (if available). By choosing an option, related form will open. However, if some forms such as ***Serial port test*** or ***Power supply*** be open, other forms couldn't be open.

ⓘScreen saver should be inactive while program works, otherwise it may cause problem in serial connection. For example if ***Sensors and Contactors*** *form is open and then screen saver be active the error may happen.*

ⓘWhile serial port is working, e.g. while receiving test results from tester, don't move mouse.

General buttons

There are common buttons in all forms so that by pressing them you can do your action.

The following buttons have more usage:

Ok (Confirmation): It is used to apply and save changes in form. In some forms after confirmation, form is closed automatically such as ***Change Password*** form***.***

Cancel: To close a form without saving changes or take back the latest data before changing. This button is totally used to cancel an action such as stop receiving data from tester via serial port.

Exit: To close a form. If you made changes in form it might be inactive. To active this button, you have to cancel the changes or apply changes (by confirmation button).

Edit: To apply and save changes in database or in a file or other resources.

Delete: Deleting information of a breaker, maneuver or ... from database.

New: Add a new record in database for defining a new breaker, new user or …

First, Next, Previous, Last: Navigate records of breaker, user or … in database

Save: Applying changes in database or file.

Do: It is used when it's going to read information automatically from tester, like applying a maneuver or calculating minimum voltage of coil operation.

Print: Sending information to printer.

Default: Some forms have ability to load default values for its parameters.

Chapter4- Program forms

To move on different parts of a form you can press ***Tab*** key or use mouse to set cursor to desired ***Box***. Meanwhile, if entering a data and pressing ***Enter*** Key, cursor will go to next ***Box***.

Each form has a name exist in one of ***menus*** as an ***option***. To active the form, it is just need to choose the ***Option*** by clicking on or pressing ***Enter*** key. For each form, related ***Menu***, ***Option***, ***Task***, ***Description***, ***Important notes*** and ***Buttons*** will come after.

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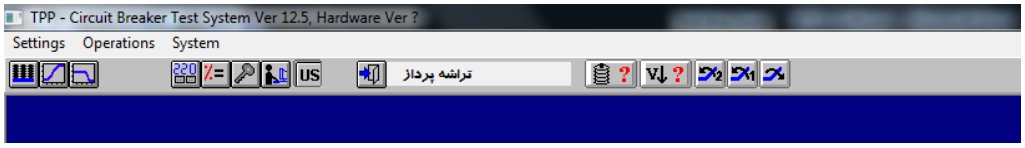
By running program, this form will be displayed, so all program facilities will be available:



Icons

 Activating page1 of ***Get Breaker Specification*** form

 Activating ***Fast test*** page of ***Get breaker specification*** form

 Activating ***Motor current*** page of ***Get breaker specification*** form

 or  Activating ***Power supply*** form

 Activating ***Calibration coefficients*** form

 Activating ***Change password*** form

 Activating ***Change user*** form

 or  Change interface language (Persian or English)

 Exit

 Connect or disconnect voltage of under voltage relay and blocking coil

 Apply maneuvers ***Open with coil2***, ***Open with coil1*** and ***Close***

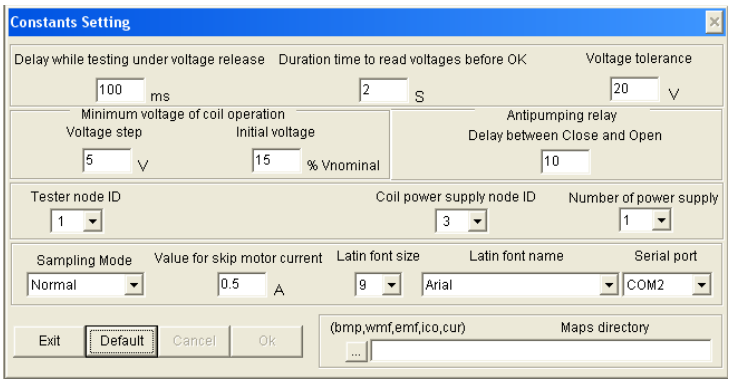
ⓘ*Last five icons work only when* ***Get Breaker Specification*** *form is open.*

Constant Setting

Menu ***Settings***, Option ***Basic information***

Task:

Determining main information of linear sensors and rotary sensor for applying a maneuver to breaker, setting serial port to make connection to tester, power supply and …



Description:

Since parameters in this form are very influential in system operation, every change should be done carefully. You can follow different sections of form here:

Voltage Tolerance: it determines limit which if voltage is higher or lower than desired voltage, voltage will be specified suitable and process will carry on. For example if it is 5 volt and desired voltage is 110 volt, voltage between 105 and 115 volt is acceptable. This value is valid between 2 to 20 volt.

Duration Time to Read Voltages Before Ok: Before applying voltage to breaker coil and motor (to do a maneuver, sampling of motor current or …), voltage must be in permitted range for duration that determined by this section. This value is valid between 0.5 to 10 second.

Delay While Testing Under Voltage Release: In testing under voltage relay (when breaker is close) to decrease voltage this delay is considered. For example if 100ms is put, it means decreasing 10 volt lasts 1 second.

Section **Anti pumping Relay:**

Delay Between Close and Open: Close and open maneuvers are applied successively for testing anti pumping relay. This parameter shows delay between these two maneuvers. This value is valid between 0 to 255ms.

Section **Minimum Voltage of Coil Operation**:

Initial Voltage: It determines a percentage of nominal voltage of open/ close coils for starting calculating minimum voltage of operation. It is valid between 10% to 80%.

Voltage Step: It determines value of voltage to be increased when calculating minimum voltage of operation. For example, if it was 3 volt, for each 3 volt increasing in voltage an open or close maneuver would be applied to breaker and coil operation would be investigated. So, lower value, more accurate voltage operation but longer test time. It is valid between 2 to 20 volt.

Number of Power Supply: Regarding to number of power supply used for coils and motor sharing or separately, you determine this box.

ⓘPower supply icon appears as follows:

 Two power supply

 One power supply

Coil Power Supply Node ID and **Motor Power Supply Node ID**: It is determined regarding to usage place of each power supply (connected to tester as power supply of coil or motor) and regarding to Node ID of power supply on its back. For example, if a power supply with node ID 2 is attached to input of motor power supply of tester, box **Motor Power Supply Node ID** must be set to 2.

ⓘIf you are using one power supply, power supply attached to input of coil of tester is considered as shared power supply for coils and motor.

Tester Node ID: Always set it to 1, Unless TAPCO company determines another number.

Section **Serial Port**:

Serial Port: It determines computer serial port no. attached to tester.

ⓘOther serial port connection settings are:

Baudrate: 19200, Start Bit: 1, Stop Bit: 1, Parity: None, Data Bits: 8

Latin Font Name and Size: It determines type and size of fonts to display phrases in forms when interface language has been set to English.

Value for Skip Motor Current: It is used for omitting time between sending command to motor to start and actual time that motor starts and consume current. For example, if it is set to 0.5A, motor current will be drawn from moment motor consume more than 0.5A and be considered

in calculating too. It should be mentioned this situation will happen only when used one power supply. It is valid between 0 to 2A.

Maps Directory: It shows folder of technical maps. This folder is used while printing maps. If you use **Browse** button, it is needed to double click on any file in desired folder until folder name is registered in this ***Box***.

Sampling Mode: Three modes are available: **Normal**, **Sensor Movement** and **Contact Action**. In **Sensor Movement** mode sampling will be started only when sensor moves. In **Contact Action** mode sampling will be started only when status of one of main contacts changes. These two modes are useful when breaker doesn't have any mechanism (close/ open coil).

Buttons:

Ok: In case of manipulating parameters, this button is activated and last changes are stored in ***sampler.ini*** by this button.

Cancel: Changes are canceled and parameters are read and filled from ***Sampler.ini*** again.

Default: Parameters are filled by default values.

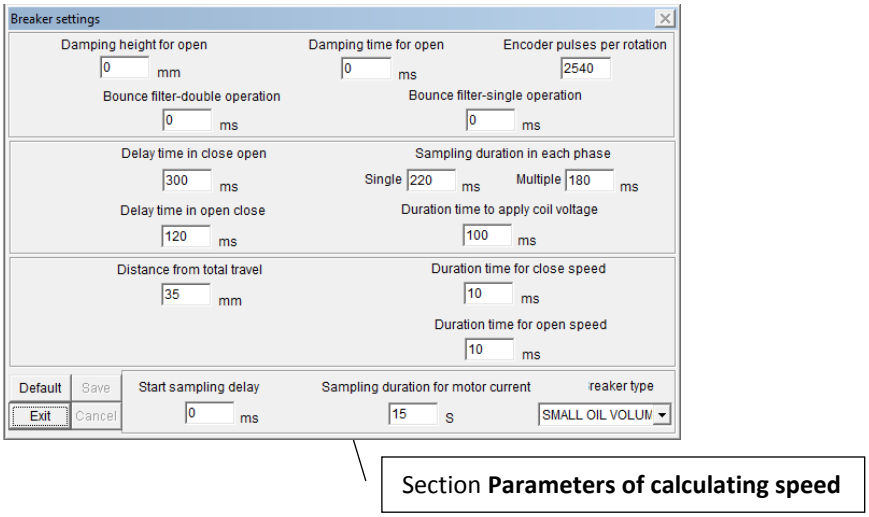
Exit: Closing form

Breaker Setting

Menu ***Settings***, Option ***Breaker***

Task:

Determining information of maneuver (Sampling time and …), parameters of calculating speed, damping lines and … according to breaker type.

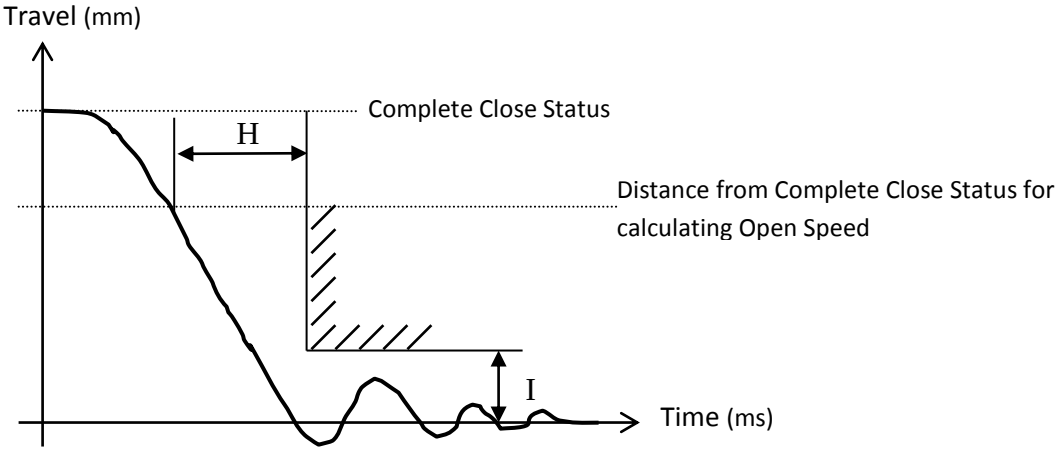


Description:

Encoder pulses per rotation: Enter number of pulses that encoder produces in one complete turn (for breakers other than vacuum type). For vacuum type breakers, enter maximum length of linear sensor. For hardware version 2 and 3 enter 19.2mm. It is valid between 12 to 256mm.

Bounce Filters: It shows permitted bounce of contacts which is omitted in displaying. It is valid between 0 to 20ms.

Damping Height and Time: Height and time to draw damping line can be seen here:



H: Damping Time

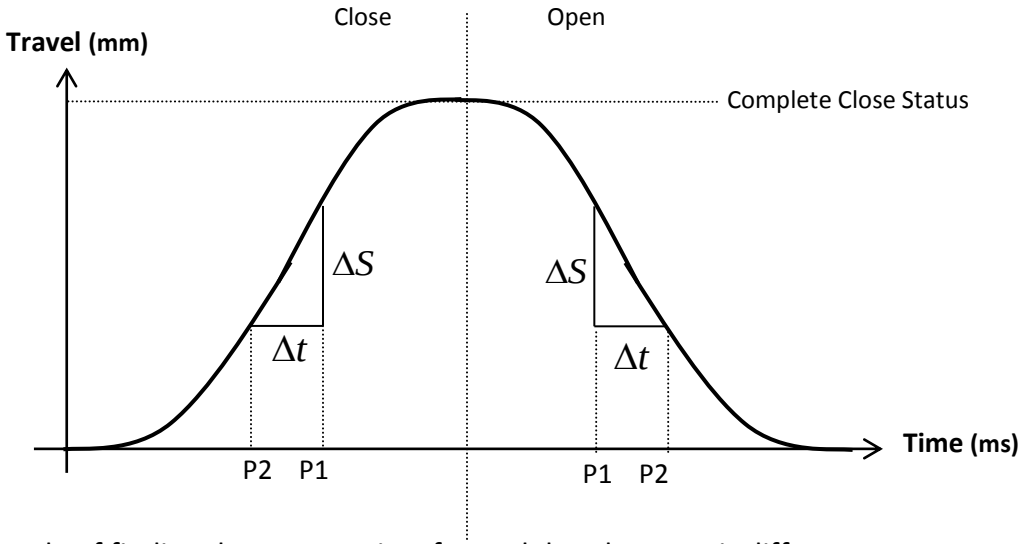
I: Damping High

ⓘDamping line is meaning only for open maneuver.

Section **Parameters of calculating speed**:

To calculate open/ close speed, two points are needed and this formula is used:

$$V = \frac{\Delta S}{\Delta t}$$



Rule of finding these two points for each breaker type is different:

Gas: Point P1 is always on the basis of half of the total movement and point P2 is on the basis of user's setting in boxes **Duration Time for Close Speed** and **Duration Time for Open Speed**.

Small Oil Volume: Point P1 is on the basis of distance form complete close status entered to this form and point P2 is according to user's setting in boxes **Duration Time for Close Speed** and **Duration Time for Open Speed**.

EDF: Point P1 is on the basis of distance form complete close status entered to this form and point P2 is according to user's setting in boxes **Duration Time for Close Speed** and **Duration Time for Open Speed**.

Vacuum: Both P1 and P2 are on the basis of distance from complete close status.

ⓘRefer to appendix1 for more information.

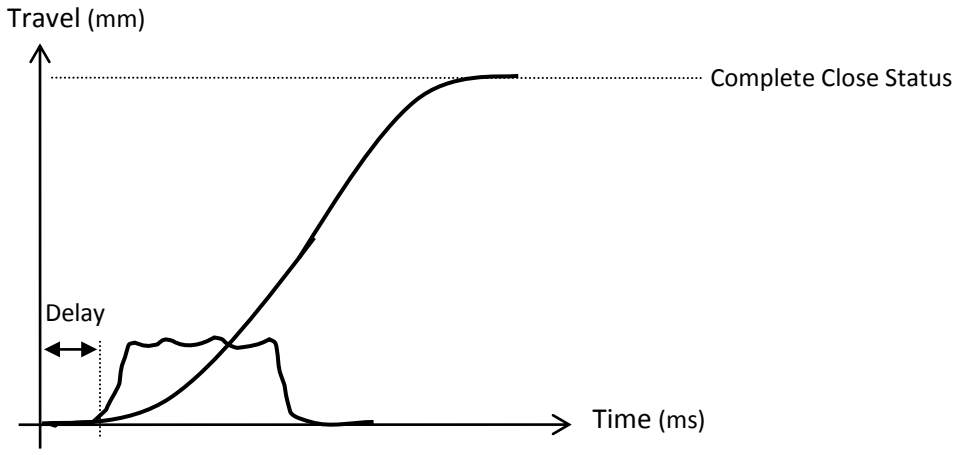
Sampling Duration in Each Phase: You can determine sampling duration time for single maneuver and multi maneuver (such as open-delay-close) separately. If this value set to low value, breaker operation curve won't be drawn completely. This setting is valid between 50 to 255ms.

Delay Time in Close-Open and **Delay Time in Open-Close**: These show delay time between applying two maneuvers. These values are valid between 0 to 500ms.

Duration Time to Apply Coil Voltage: It shows maximum time of applying voltage to coil while a maneuver operates. If this value set very low, coil may not operate at all. This value is valid between 20-200ms.

Sampling Duration for Motor Current: It shows maximum time duration of sampling motor current. This value is valid between 5-40ms.

Start Sampling Delay: If in drawing motor current and coil current curve there is a delay between sampling start and coil consuming current, it will effects on extracted times as time of contacts operation. To omit this delay you can use this box, it is just enough to enter delay between sampling start and coil consuming current. This set is valid between 0 to 255ms.



Buttons:

Save: In case of manipulating parameters, this button is activated and last changes are stored in database (table ***Breaker Settings***) by this button.

Cancel: Changes are canceled and parameters are read and filled from database again.

Default: Parameters are filled by default values.

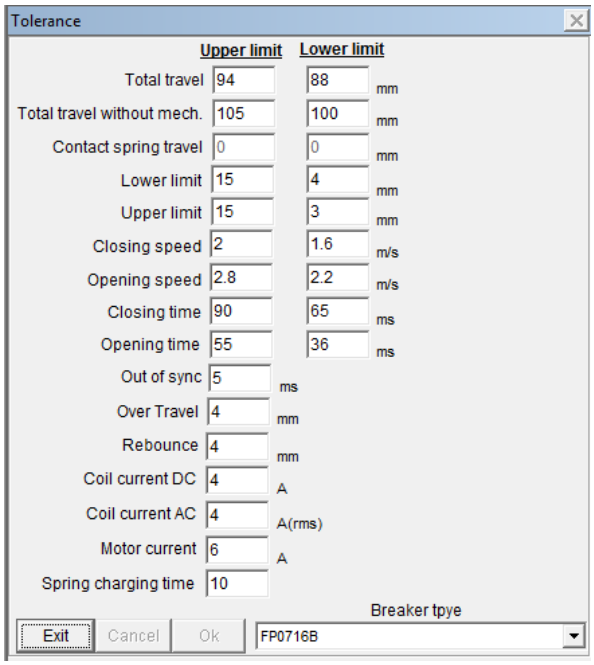
Exit: Closing form

Tolerance

Menu ***Settings***, Option ***Tolerance***

Task:

Determining the most and least permit limits for breaker parameter on the basis of breaker type.



Description:

Measures entered in this form are checked in close or open maneuver and result will be appeared as a table. Out of limit parameters are red.

*ⓘRefer to description of **Get Breaker Information** form, **routine Test** page in this chapter.*

Buttons:

Ok: In case of manipulating parameters, this button is activated and last changes are stored in database (table ***Tolerance of Parameters***) by this button.

Cancel: Changes are canceled and parameters are read and filled from database again.

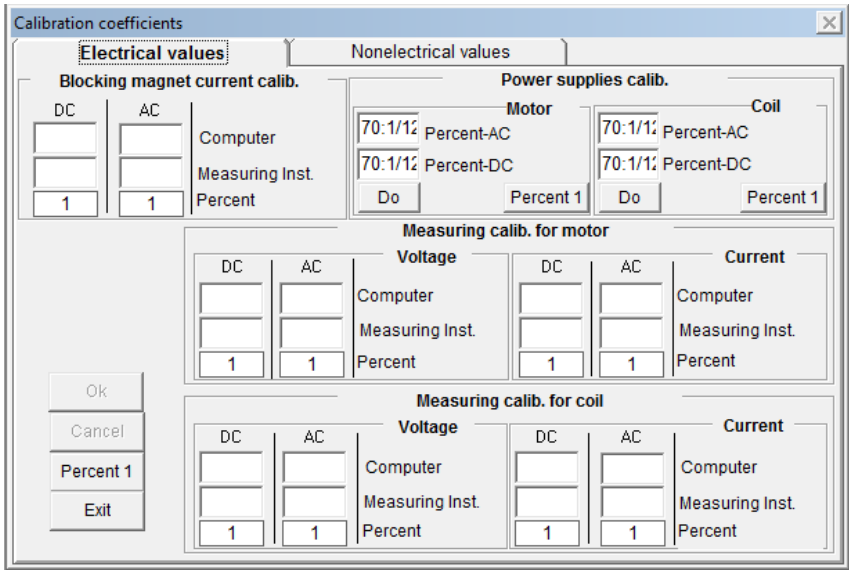
Exit: Closing form

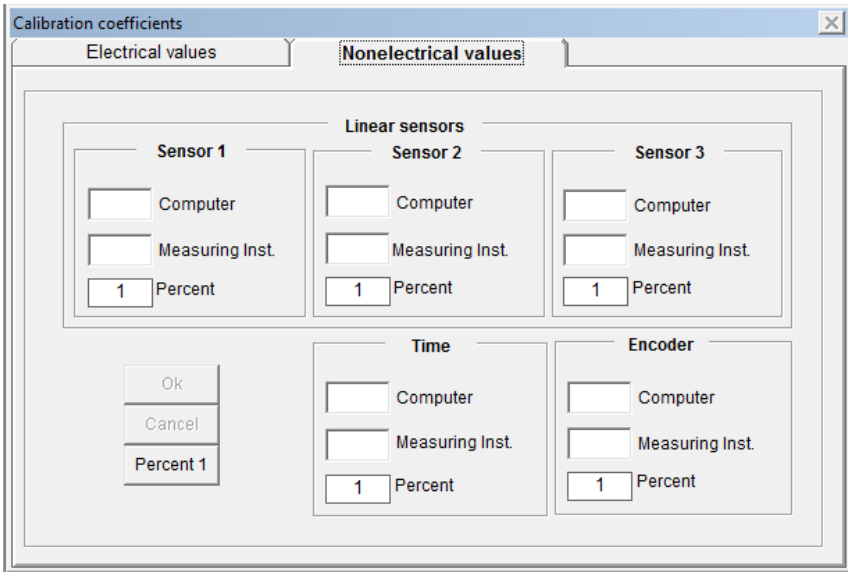
Calibration Coefficients

Menu ***Settings***, Option ***Calibration Coefficients***

Task:

Determining the calibration coefficient of power supply, measuring voltage and current, linear sensors, rotary sensor (encoder) and time.





Description:

All system calibration coefficients are determined and set here. Before setting each calibration coefficient, firstly set it to 1 and save it, then according to the method will be explained here recalculate it. It's better to calculate it for middle of range. For example, if voltage is between 0 to 255 volt, calculate calibration coefficient with 128 volt.

ⓘAny changes in this form must be done carefully.

Calibration coefficient of power supply is done automatically in voltages 70, 128, 160 and 200 volt.

Calibration method for measuring voltages:

1. Set calibration coefficient to 1 and save it (by ***Ok*** button).
2. Put a precise calibrated voltmeter in power supply output.
3. Open ***Power supply*** form, choose desired power supply voltage option, put setting of voltage on 128 volt and set voltage type (AC or DC).

*ⓘTo introduce to **Power supply** form go to its description here.*

4. Read voltage from ***Power supply*** form and voltmeter at the same time and take note.
5. Close ***Power supply*** form. Enter read voltage from ***Power supply*** form in ***Computer*** box and voltmeter voltage in ***Measuring inst.*** box (in ***Calibration Coefficients*** form). Save these changes by pressing ***Ok*** button.

Now, calibration coefficient will be calculated and shown. To make sure, open ***Power supply*** form again and set voltage on different values and investigate the similarity between voltage shown on computer and voltmeter.

ⓘIn this stage, your desired voltage may be different from set on power supply. To solve this problem you should correct calibration coefficient of power supplies (follow next). In other word, by setting calibration coefficient of measuring, only voltage which is shown in program is equal to power supply voltage output (not equal with actual voltage).

ⓘ±2 volt difference is acceptable.

Calibration method for measuring motor current:

1. Set calibration coefficient to 1 and save it (by ***Ok*** button).
2. Attach a load to power supply output of motor (which exit from tester) which consumed current is half of maximum motor current (e.g. 2.5A).
3. Add a precise and calibrated amperemeter with load serially.

4. Open ***Power supply*** form and choose current option, set current type (AC or DC).
5. Read and take note of current shown in ***Power supply*** form and amperemeter at the same time.
6. Close ***Power supply*** form and enter displayed current in this form in ***Computer*** box and amperemeter current in ***Measuring inst.*** box (in ***Calibration Coefficients*** form). Save these changes by pressing ***Ok*** button.

Now, calibration coefficient will be calculated and shown. To make sure, open ***Power supply*** form again and by changing load, investigate the similarity between current shown on computer and amperemeter.

Calibration method for power supplies:

Calibration coefficient is calculated automatically by pressing ***Do*** button related to desired power supply (coil or motor).

ⓘThis section is defined only for using TAPCO power supplies. It isn't effective for others. For other power supplies you must set these coefficients to 1 by pressing ***Percent1*** *button.*

ⓘBefore calculating calibration coefficients of power supply, always first determine calibration coefficients of measuring. If you changed measuring calibration, definitely calculate calibration coefficients of power supplies again.

Calibration method for linear sensors:

1. Set calibration coefficient to 1 and save it (by ***Ok*** button).
2. Open ***Sensors and Contactors*** form.
3. Attach sensor to one of tester inputs (fitted with number which is being calibrated) and move sensor's shaft so that you see 0 on computer.

ⓘStatus of zero of sensor should be the way that if its shaft comes out 0.075mm this measure is shown on computer. For this, put shaft in the way that computer shows measure more than 0. Then push shaft calmly into the sensor and fix it as soon as computer changes from 0.075mm to 0. Then suppose this outgoing measure as zero point for this sensor.

4. Take out sensor's shaft from zero to 9.6mm (middle range for 19.2mm) by a precise calibrated caliper.
5. Enter the measure shown on form ***Sensors and Contactors*** in ***computer*** box and measure shown on caliper in ***Measuring inst.*** box (in ***Calibration Coefficients*** form). Save these changes by pressing ***Ok*** button.

Now, calibration coefficient will be calculated and shown. To make sure of validity of this coefficient, open ***Sensors and Contactors*** form again and by changing length of sensor's shaft and measuring it with regard zero point of caliper, investigate the similarity of length in computer and caliper.

ⓘBefore calculating calibration coefficient of linear sensors, calibrate sensor circuits as instruction in hardware manual.

Calibration method for rotary sensor (encoder):

1. Set calibration coefficient to 1 and save it (by ***Ok*** button).
2. Open ***Sensors and Contactors*** form.
3. Put encoder axis in hypothetical zero situation and in computer, set the number of encoder pulses and turning angle to zero by ***zero*** button.
4. Turn encoder axis approximately to the half of the maximum turn by calibrated and precise goniometer. For example, turn 55 degree for ***Small oil volume*** breakers with maximum 110 degree turn.
5. Enter angle seen in ***Sensors and Contactors*** form in ***computer*** box and angle shown by goniometer in ***Measuring inst.*** box (in ***Calibration Coefficients*** form). Save these changes by pressing ***Ok*** button.

Now, calibration coefficient will be calculated and shown. To make sure of validity of this coefficient, open ***Sensors and Contactors*** form again and by turning encoder axis investigate the similarity between angle shown in computer and goniometer.

Calibration method for time:

1. Set calibration coefficient to 1 and save it (by ***Ok*** button).
2. Put a precise and calibrated chronometer on one breaker contacts so that it starts counting by closing contact and stop counting by opening contact.
3. Go to ***Routine test*** page in ***Get Breaker Specification*** form and run a close-open maneuver simultaneously.
4. Enter time duration appeared in this form as contact operation time in ***Computer*** box and time duration shown by chronometer in ***Measuring inst.*** box (in ***Calibration Coefficients*** form). Save these changes by pressing ***Ok*** button.

Now, calibration coefficient will be calculated and shown.

ⓘThis method is a suggestion and you can do it by any other methods.

ⓘWhen each part of software, tester, power supply, encoder or linear sensors change, you have to calculate calibration coefficients again. For example, if you need to install software again,

*you should be careful that file **Sampler.ini** isn't destroyed (copy it before installing and restore it after installing).*

Buttons:

Ok: In case of manipulating parameters, this button is activated and last changes are stored in file ***Sampler.ini*** by this button.

Cancel: Changes are canceled and parameters are read and filled from in file ***Sampler.ini*** again.

Percent1: Puts all calibration coefficients to 1.

Exit: Closing form

Get Breaker Specification

Menu ***Operations***, Option ***Breaker test information***

Task:

Getting information of breaker such as serial number, nominal voltages, resistance of electrical equipments from user and gathering other information like motion curve, coil and motor current via tester and saving all these information in database.

Description:

For text box entered by user, you should do that by putting cursor on the box (by clicking mouse or tapping on ***Tab*** button) and then typing suitable value.

ⓘIf it's required to be confirmed with user code, it's enough to click on related box twice to register user code automatically. If user code has been registered before, this would cause in deleting the code.

ⓘYou can change user code whenever you want. Refer to ***Change User*** *form for more information.*

This form is contained of some pages as follow:

ⓘIn all pages, appeared titles can be changed by clicking twice on them. This change is implemented for each breaker type separately and you can see effect on screen.

Page 1

You can define a new breaker in this page, view information related to predefined breaker, save and change information or delete breaker information.

The most important characteristic of a breaker is its serial number which should be unique. After entering information of a new breaker, it must be saved in database by ***Save*** button. All information is changeable except breaker type. To do this, you have to delete all done maneuvers of breaker.

ⓘIt is strongly advised before doing maneuver, precisely determine breaker type and test parameters (in ***Breaker Settings*** *form).*

ⓘChanging different models of the same breaker type is possible.

ⓘDifferent models of breaker types are:

Small Oil Volume:

- HL620

Gas:

- FP0716B
- FP1216B
- FP2416B
- FP0731D
- FP1225D
- FP2425D
- FP3625D
- FP3616B

EDF:

- EDF SK 1-1

Vacuum:

- VD4P
- VD4E

You can add desired models in table ***Breaker Constants*** of database (***Breaker.mdb***).

By entering nominal voltage, maximum and minimum of nominal voltage will be calculated automatically basis on determined standard type.

*ⓘRefer to **Appendix1** for more information.*

*ⓘIf you right click above of buttons **Next, Previous, …** a list will be appeared that shows done maneuvers for chosen breaker.*

*ⓘIn **Wiring Map** box, if you type map number in left box and **Enter**, this number will be appeared on the right box as file name. Be careful, if only branch of map file is .WMF, it isn't needed to mention file branch on the right.*

Buttons:

New: Defining a new breaker

Edit: Applying changes to breaker information in database. Be careful that changes of all pages and even changes on maneuvers (unsaved maneuvers or deleted one) are applied altogether in database.

Delete: Removing a breaker from database (along with done maneuvers).

Save: Saving a new breaker. It is activated only when a new breaker is defined.

Cancel: Canceling applied changes. All information of breaker is read again from database and shown. Unsaved maneuvers will be omitted.

First, Next, Previous, Last: It is used to navigate records in database to observe information of saved breakers in database.

Page2

You can enter measures in different parts of resistance of electrical equipments. To register or delete your user code, click twice in different boxes of ***Control*** section (other than anti pumping relay box).

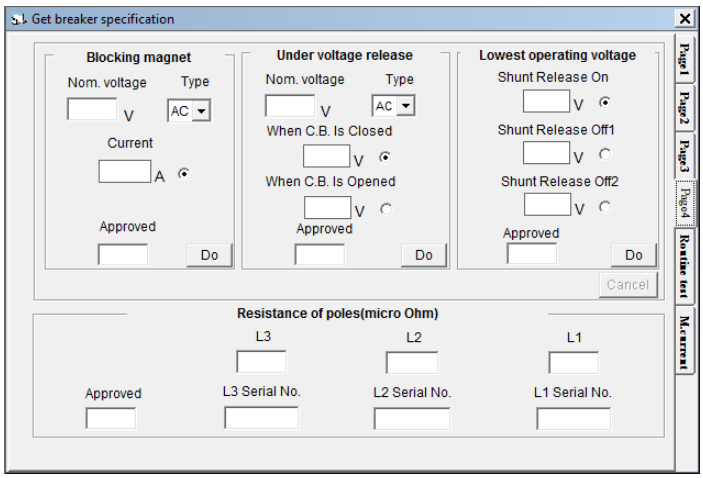
Method of testing anti pumping relay

1. By pressing ***Do*** button, test is started.
2. Breaker must be close and spring must be charge. If breaker is open, a close maneuver will be applied automatically.
3. Setting form of voltages is activated and after setting of voltages, open-close maneuver is run. Delay between these two maneuvers is determined in ***Constants Setting*** form***.*** If breaker isn't become open, error message will be appeared and test will be stopped.
4. There's pause about 6 seconds. After this time, if breaker mustn't be reclosed, anti pumping relay will be confirmed.

Page3

Sections ***Pressure of poles*** and ***Primary Relay*** are appeared or disappeared according to breaker type. Sections whose measures should be entered by user it is done by putting cursor there and entering measure and section that need user confirmation (by registering user code) are done by clicking mouse twice.

Page4



Calculating minimum voltage of open or close coil operation

1. Choose desired coil by clicking on the circle next to it.
2. Press ***Do*** button in ***Lowest Operating Voltage*** section.
3. If breaker status is not suitable to continue (for example you choose close coil while breaker is close too, thus close maneuver cannot action) proper maneuver will be applied to breaker.
4. Power supply voltage of coil must be set lower than minimum measure which is equal to percent of nominal voltage that is determined in ***Constants Setting*** form. If power supply is controllable by program, this set is done automatically, other than user has to do that.
5. After setting voltage, calculating minimum voltage operation of selected coil is started that means applying suitable command to breaker. If breaker doesn't action, voltage increases regarding to the ***Step*** which has been determined in ***Constants Setting*** form and command is applied again. It is continued until breaker action or voltage increases more than maximum permitted measure.

ⓘIf power supply is increased by user, increasing should be done slowly.

*ⓘIn each above stages you can cancel test by pressing **Cancel** button.*

Testing Under voltage relay in close status

1. Click on option of this test.
2. Press ***Do*** button in ***under voltage Release*** section***.***
3. Breaker must be close. Otherwise suitable maneuver (close) is applied to breaker.
4. Voltage of coil power supply must set to nominal voltage of under voltage relay. If power supply is controllable by program this set is done automatically. Other than user should do that.

5. By decreasing voltage gradually (with speed which is determined by ***delay while testing under voltage relay*** box in ***Constants Setting*** form) test of under voltage relay is done. In each voltage that breaker is open, that voltage will be recorded as operation voltage of under voltage relay in close status.

Testing Under voltage relay in open status

1. Click on option of this test.
2. Press ***Do*** button in ***under voltage Release*** section***.***
3. Breaker must be open. Otherwise suitable maneuver (open) is applied to breaker.
4. Voltage of power supply of coil must set to 20 volt. If power supply is controllable by program this set is done automatically. Other than user should do that.
5. ***Power supply*** form is opened. There are two Buttons ***Ok*** and ***Exit***. By increasing or decreasing voltage here when under voltage relay operates (voice of relay shunt is heard or seen) press ***Ok*** until voltage of power supply is recorded as operation voltage of under voltage relay in open status. If ***Exit*** is pressed, ***Power supply*** form is closed and no change is done.

*ⓘBy pressing **Cancel,** operation is canceled.*

Calculating blocking coil current

1. Press ***Do*** button in ***Blocking magnet*** section.
2. Breaker must be open. Otherwise suitable maneuver is applied to breaker (open).
3. Power supply of coil should be set to nominal voltage of blocking coil. If power supply is controllable by program this setting is done automatically, otherwise user must to do that.
4. Samples of blocking coil current for 6 seconds are gathered by tester and will be sent to computer.
5. In computer mean of current for the last 10 samples is calculated and recorded as blocking coil current.

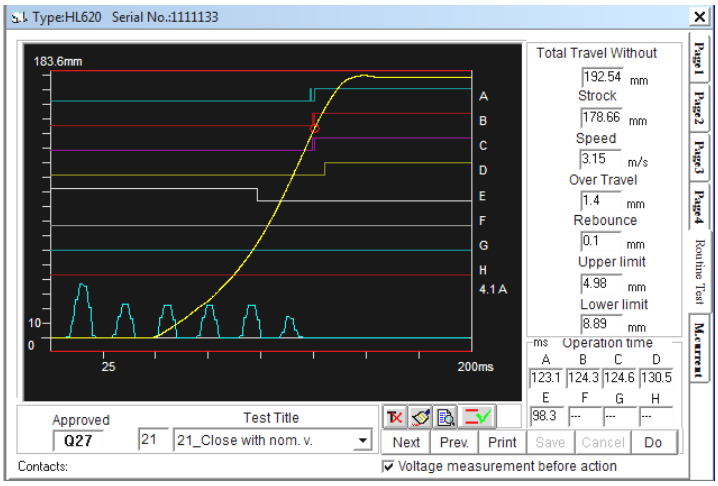
Buttons:

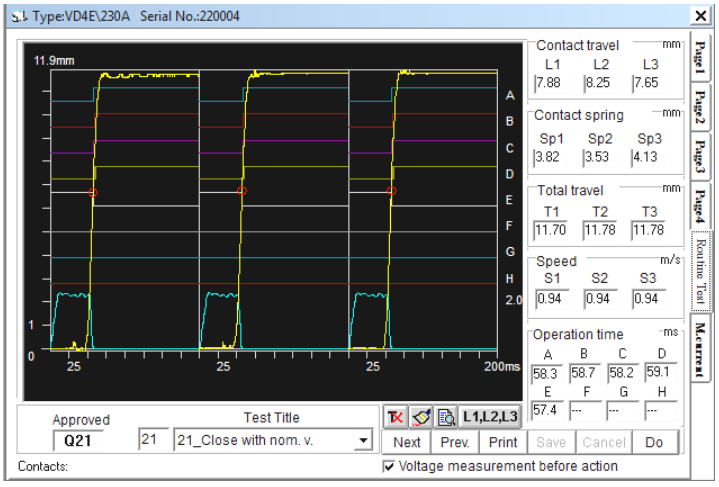
Do: Starting operations to calculate minimum voltage for coil operation, testing under voltage relay and blocking coil current.

Cancel: Disconnects serial port and stopping running operation.

Routine Test

Information appeared in this page is different based on breaker type and maneuver. In following pictures, status of this form is shown for two kinds of breaker: ***Small Oil Volume*** and ***Vacuum*** types.





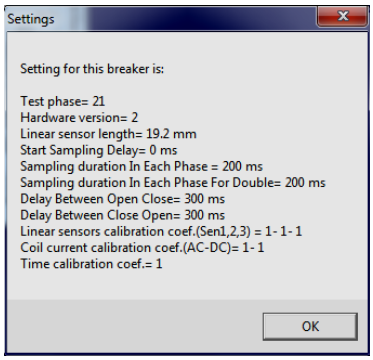
In the following, you can see more about appeared pictures:

 Safety limits haven't been calculated yet.

 Safety limits have been calculated.

ⓘby using this icon you can calculate safety limits.

 Displaying test parameters of selected maneuver. Appeared form is like this:



 Redrawing curve and recalculating parameters of curve that is shown on the right of curve. For example, when you change setting of time filters or damping line in ***Breaker settings*** form***,*** by using this icon you can see effect of changes on curve.

 Shows some parameters aren't in permitted limits.

 Shows all parameters are in permitted limits.

ⓘby using this icon you can see tables of breaker test parameters status and limits. Out of range parameters are red. Appeared table will be disappeared if you click on this icon or table. This table is as follow:

Parameter	L.limit	Breaker	U.limit
Total travel	78	0	84
Travel(No Mech)	90	---	95
Lower limit	2	----	15
Upper limit	3	----	15
Over travel		0	4
Rebounce		0	4
Close speed	1.6	0	2
Close time	65	83.7	95
Out of sync		0	5
Coil current		2.6	4

L1,L2,L3 Motion curve of 3 poles of vacuum breaker are shown near each other.

L1,2,3 Motion curve of 3 poles of vacuum breaker are shown on each other and in common coordinate axis.

L× Only motion curve of one of poles is shown.

Running a maneuver

Select maneuver from list or enter maneuver number on left side of list and press ***Enter*** button. Now, press ***Do*** button. Setting voltage form will be opened. If voltages are set correctly command of maneuver will be sent to breaker and result will be shown. When program is connected to tester (for example, while receiving motion curve data) by pressing ***Cancel*** button operation is stopped. Test parameters of each applied maneuver will be based on the last setting in ***Breaker settings*** form. If a maneuver was run, icon shows parameters which maneuver has been applied base on them and if a maneuver was not run, settings in ***Breaker settings*** form shows settings which maneuver will be run based on them.

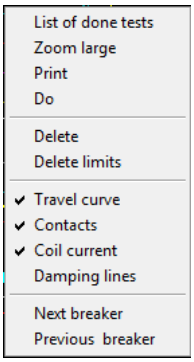
ⓘEach maneuver can be done according to independent settings from other maneuver.

*ⓘFor controllable power supply by program, they are turned on in starting maneuver. They are turned off just when pages other than **page4**, **Routine test** page and **motor current** page are activated.*

If you move mouse on motion curve while holding left click, time and measure of contact movement will be shown and if leave the mouse button, a list of information contained time, movement, speed and coil current will be appeared.

ⓘBy clicking on appeared list, it will be disappeared.

By right clicking on mouse while it is in displaying curve area, a list of facilities is shown which is included of:



List of done tests: Titles of done maneuvers be visible or not.

Zoom large: Shows curves in a new form and bigger. By making this form smaller, you can see two different maneuver of a breaker (even two different breakers) at the same time.

Print: It is used to print curves.

Do: It is used to apply a maneuver.

Delete: It is used to delete a done maneuver. To delete maneuver from database completely, you must press ***Edit*** button on ***Page1***.

Delete limits: To deleting safety limits calculated before.

Travel curve, Contacts, Coil current, Damping lines: It is used to show or hide each of them.

Next breaker, Previous breaker: It is used to navigate database.

*ⓘNotice the difference between these two option and task of **Prev.** and **Next** buttons (comes afterwards).*

Calculating safety limit:

By clicking on its icon, calculating is started. Messages will help you to do this operation.

*ⓘTo stop operation it is just enough to press on **Cancel** button.*

Buttons:

Do: To start a maneuver.

Save: Just it saves displaying maneuver.

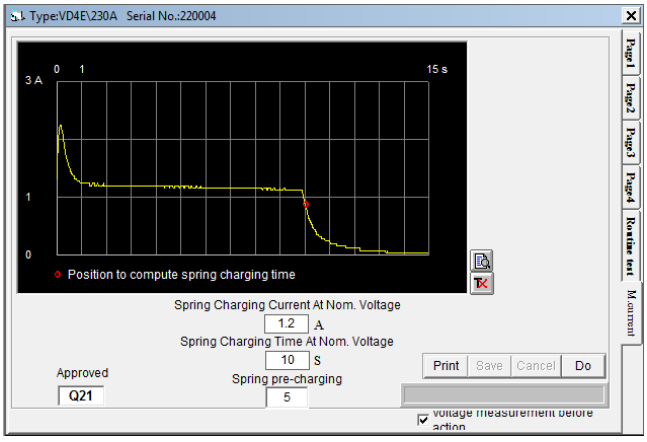
Next, Prev.: To move on maneuvers.

Print: To print curves on printer.

Cancel: To disconnect serial connection.

Motor Current

In this page, you can see and sample from motor current in time of charging spring. Maximum time of sampling time is gained from ***Breaker Settings*** form.



Icons:

 Displaying test parameters.

 Some test parameters aren't in permitted limit.

 All test parameters are in permitted limit.

ⓘBy using this icon, you can see table of breaker parameters status and Hi-low limits. By clicking on table or icon, table is disappeared.

To start, press **Do** button. Setting voltage form is opened. Breaker must be open. If breaker isn't open, an open maneuver is applied to breaker automatically. After setting voltages, close command is applied to breaker and data of motor current is sampled. When program is connected with tester by pressing ***Cancel*** button, you can stop the operation. Test parameters are based on the last setting in ***Breaker Settings*** form while getting motor current data. If motor current test was run, icon  shows parameters which test has been applied base on them and if test was not run, settings in ***Breaker settings*** form shows settings which test will be run based on them.

Buttons:

Do: Starting sampling motor current.

Save: Saving motor current curve in database.

Print: Printing curve on printer.

Cancel: Stopping serial connection.

Fast Test

In ***Operations*** menu, there is also ***Fast Test*** option which has approximately the same task as routine test but with below differences:

1. Done maneuver in ***Fast Test*** form cannot be saved.
2. If maneuver type is ***Open*** or ***Close***, proper maneuver will be applied to breaker regarding to breaker status regardless to chosen maneuver. Notice that in ***Routine Test*** page if breaker status is not suitable to accept maneuver, error message will be shown. Therefore, in this page by pressing ***Do*** button an ***Open*** or ***Close*** maneuver will be done.
3. Voltage level and open coil no. (1 or 2), are selectable in this page.

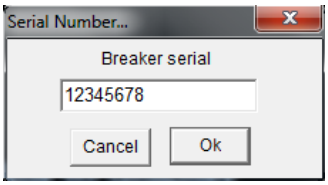
4. If you choose and run one of combined maneuvers but breaker status is not suitable, an ***Open*** or ***Close*** maneuver is done at first and then whenever run is pressed, user maneuver is run (title of this maneuver is existed on ***Do*** button).
5. By pressing ***F1*** to ***F6*** buttons, you can run maneuvers directly:
   - **F1**: Close
   - **F2**: Open
   - **F3**: Open-Close
   - **F4**: Close-Delay-Open
   - **F5**: Open-Delay-Close
   - **F6**: Open-Delay-Close-Open
6. If you change breaker setting or calibration coefficients, done maneuvers in this page are deleted and aren't displayed.

Serial Number …

Menu ***Operations***, Option ***Serial Number…***

Task:

Searches and displays information of desired breaker.



Description:

In order to show information of a certain breaker, enter its serial number in this form. If breaker is found in database, it is displayed and if it is found in ***Backup*** database, suitable message is appeared.

This form is activated only if ***Get Breaker Specification*** form is open.

Buttons:

Ok: Starting searching serial number in database.

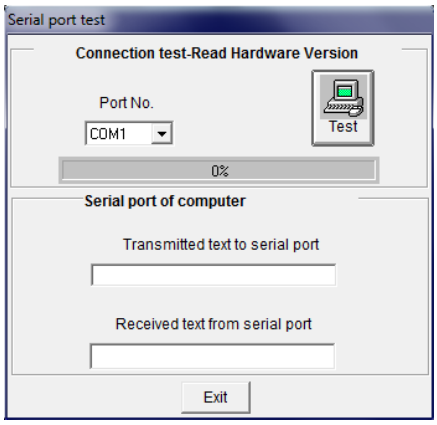
Cancel: Closing form and stopping search.

Serial Port Test

Menu ***Operations***, Option ***Serial port test***

Task:

Testing computer serial port and testing connection with tester.



Description:

Connection of computer to tester is investigated. To do this, click on related icon  . If it is connected, √ sign and if there is no connection × sign is appeared on icon.

ⓘIf you change serial port no. in this form, this setting will be saved as active serial port.

To investigate correct operation of computer serial port, separate cable from computer and connect ***Loop back*** connector to computer serial port. Enter letters or digits in ***Transmitted text to serial port*** box. If all of these entered letters and digits are appeared in ***Received text from serial port*** box, serial port of computer is right. Otherwise, if result is negative, serial port is spoiled.

To test cable, connect cable to computer serial port and connect ***Loop back*** connector to other side of cable (instead of tester) and then repeat test method described above. If result is negative, cable is spoiled.

*ⓘ**Loop back** connector information exists in hardware manual.*

Buttons:

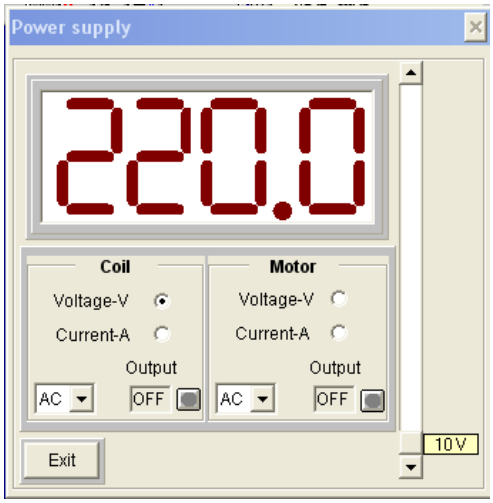
Exit: Closing form. When serial port connection is active this icon is inactive. Also, the last setting of serial port no is saved as active port.

Power Supply

Menu ***Operations***, Option ***Power Supply***

Task:

Displaying voltage and current of power supply with ability to set voltage.



Description:

For both power supplies of coil and motor, ability to display voltage and current, determining voltage and current type (AC, DC) and turning them on and off are existed. For current, just displaying is possible but about voltage, you can set it too.

ⓘIf voltage difference is a lot from what is set on power supply, you have to recalculate calibration coefficient of measuring voltage and current, and calibration coefficient of power supply.

ⓘIf output of power supply is off by on/ off key or by special key in the back of power supply, setting voltage will be done according to user measurement and set voltage will be shown as soon as power supply turned on.

ⓘVoltage setting is possible from 10 to 255 volt.

In case of displaying coil current, it is noticeable that because coil voltage route is closed only in time of running a maneuver or calculating minimum voltage of coil operation and so on (and it is open in normal state) to see output current of coil power supply you must use AUX output.

ⓘⓘIf you want to touch output of power supply, you should disconnect its output by key which is behind power supply case. So, it is not enough just sending disconnect command from

program because any disturbance in system operation (like disturbance in city power) may cause reconnecting output.

ⓘit is clear that cases such as setting voltage or disconnecting supply output is only right for controllable supplies produced by TAPCO.

Buttons:

Ok: It appears just when form is open because of **Testing under voltage relay in close status** and it is used to record voltage.

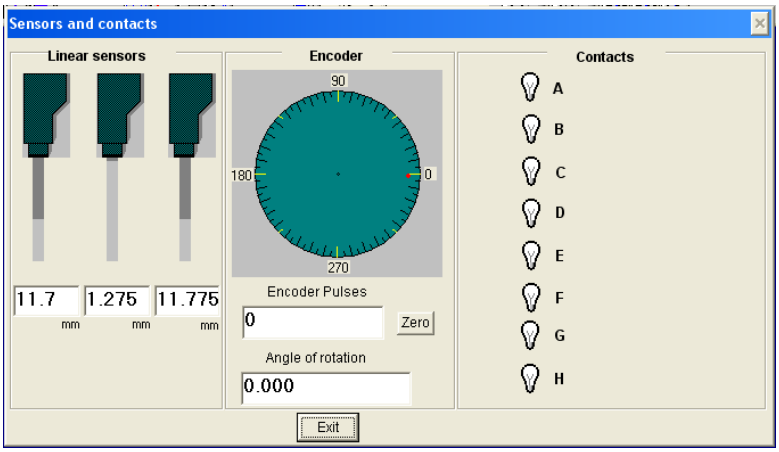
Exit: To close form.

Sensors and Contactors

Menu ***Operations***, Option ***Sensors and Contactors***

Task:

Displaying linear sensors status, encoder and contacts (main and auxiliary).



Description:

Length of each linear sensor is displayed in related section. Precision of measuring linear sensor movement is equal with **length of linear sensor/256**

Linear sensor's length is measured entered by user in ***Breaker Settings*** form (for vacuum type). If this length is 19.2mm, measure precision will be 0.075mm.

In ***Encoder*** section, additionally to show turning encoder axis graphically (from 0 to 360 degree), it is shown total number of produced pulse in encoder output and also turn angle.

Whenever you want, you can make number of pulses and turn angle to zero by pressing ***Zero*** button. Use this ability to determine reference point (zero point) to test encoder.

ⓘprecision of measuring turning of encoder is equal with ***360/number of encoder pulses in a complete cycle****.*

Number of encoder pulses in a complete cycle is what you entered in ***Breaker Settings*** form. If measure is 2500, precision will be 0.144 degree.

In ***Contacts*** section, each contact which is open is displayed by **off** lamp and close one with **on** lamp.

Buttons:

Zero: Position of encoder is thought as zero and number of pulses and turn angle becomes zero.

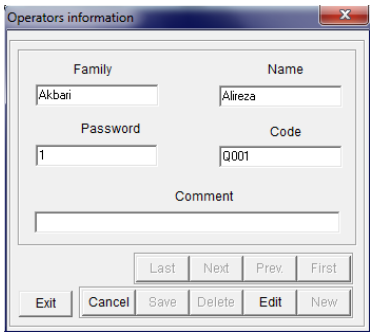
Exit: To close form.

Operators Information

Menu ***System***, Option ***Operators Information***

Task:

Adding, Deleting or Changing names and features of permitted users.



Description:

This option is only active when you enter specific password of supervisor. In other word, just supervisor can change user's information.

ⓘTo know supervisor's password, call TAPCO.

Whatever is entered in ***Code*** box is used as user signature to confirm some parameters in ***Get Breaker Specification*** form.

Buttons:

First, Next, Previous, Last: Navigate user's information records.

New: To define new user.

Edit: To apply Changes in database of user's information.

Delete: To delete one user from permitted users.

Save: To save information of a new user.

Cancel: To cancel applying changes in database.

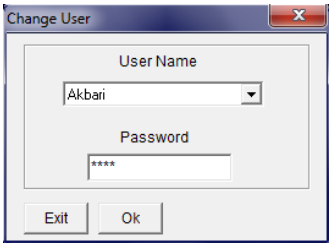
Exit: To close form.

Change User

Menu ***System***, Option ***Change User***

Task:

Changing user logged in program



Description:

This form is active both after running program and through this option. By choosing user name from list and entering password, user's code will be used in program as user signature whatever it is needed.

ⓘAfter trying 3 times to enter password, error message appears and program is finished.

Buttons:

Ok: After entering password you must press this button.

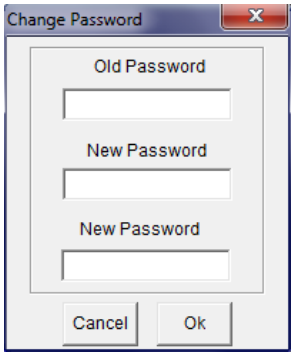
Cancel: If you are at start of program, program will be finished, but if you run program before and you open this form to change user, it will mean you regret changing user.

Change Password

Menu ***System***, Option ***Change Password***

Task:

Changing user's password who has run program



Description:

Every user who run program can change his password. To change password, it is need to enter new pass word twice addition to previous password.

ⓘAfter pressing **Ok** *notice to appeared message to make sure of changing password.*

ⓘIn case of forgetting password, ask supervisor to remain you by using ***Operators Information*** *form.*

Buttons:

Ok: Registering new password

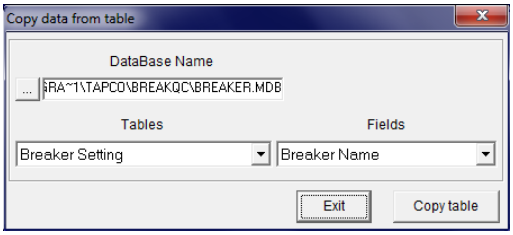
Cancel: Canceling password changes

Copy Data from Table

Menu ***System***, Option ***Copy Data from Table***

Task:

Copy information from a database to main database of program.



Description:

It may be needed to copy information of some tables from a database to main database of program (***Breaker.mdb***). For example, when a program reinstalled and we want to copy permit limits of breakers from other installed folder so not to need to redefine the same permit limit in this new installed program. To do this it is enough by using icon ... you can choose table ***Breaker Settings*** of desired database to copy old setting to main database of new program.

Buttons:

Copy table: Starting copy information from selected database to main database

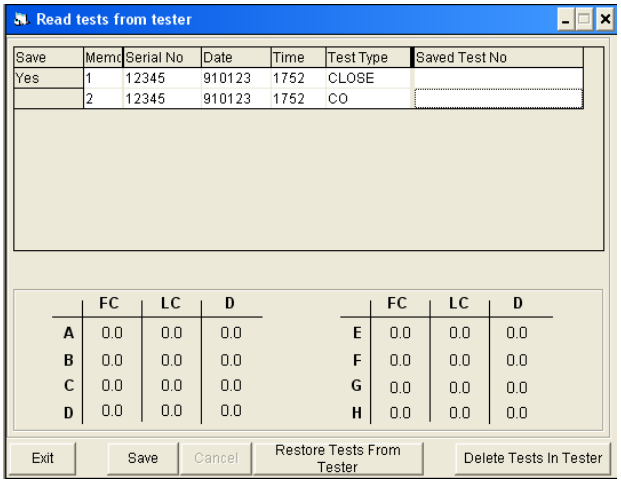
Exit: To close form

Restore Tests from Tester

Menu ***System***, Option ***Restore Tests from Tester***

Task:

Reading saved tests from tester and saving them in main database of program.



Description:

At most 96 tests are savable in tester. You can see tests here with their features like serial number, date of test and you can select which one you want to restore.

Each test which has ***Yes*** in ***save*** column will be saved in program database. To register ***Yes,*** click twice on ***save*** column on desired row. To delete ***Yes***, do it again.

Following list is appeared by right clicking on list of tests:

Filter: For example to see tests of a specific serial number, click on serial number then right click and select ***Filter*** to see only tests of that serial number.

Delete filter: It is used to delete filter and see all tests in list.

Restore All: In ***Save*** column of all rows, ***Yes*** will be appeared.

Restore None: Remove ***Yes*** from all rows.

Buttons:

Delete tests in Tester: Deleting tests from tester memory. So, there is no test in tester memory after doing this.

Restore tests from tester: By pressing it, tests saved in tester are read and their information is shown in list.

Save: Each test containing ***Yes*** in its ***Save*** column, it will be saved in program database.

Cancel: Stops serial connection.

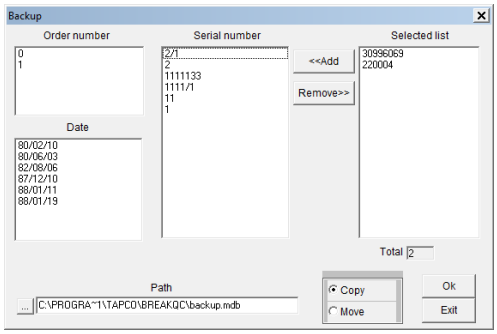
Exit: To close form.

Backup

Menu ***System***, Option ***Backup***

Task:

To get copy of breakers information based on date, order number and serial number



Description:

Enter path and name of backup database in ***Path*** box. To select database use icon ...

To select a serial number (transfer them to backup check list labeled ***Selected list***) do as follow:

1. Directly selection of one or some serial numbers from ***Serial number*** list. By clicking twice on a serial no, it is added to ***Selected list***. Also if you selected some serial no sequentially (by holding left button of mouse and move it on serial numbers) You can altogether to select serial numbers list by clicking on <<Add.
2. To choose a group of serial numbers which have the same order number, by clicking on desired ***Order number*** list***,*** all serial no which have the same order number are selected. Now, add altogether to ***Selected list*** by clicking <<Add.
3. To choose a group of serial number which have the same test date, by clicking on desired date, all serial no tested at that date are selected. Now, by clicking <<Add send altogether to ***Selected list.***

If you want selected serial no not to be deleted from main database after adding to backup database, select ***Copy*** and if you want to delete them after adding to backup database, select ***Move***.

If selected serial no exist in backup database, user will be informed and if user wants, it is overwritten.

ⓘIf there is a backup database in advance (in selected folder), selected serial number are added to it.

*ⓘAll of serial numbers in main database (**Breaker.mdb**) will always be shown to make backup from them.*

*ⓘAfter finishing creating backup database, a file will be created with the same name of backup database but with **.LST** extension which contains serial numbers and number of them.*

Buttons:

Add>>: Transferring selected serial no in ***Serial number*** list to backup checklist to be added to backup database.

<<Remove: Deleting selected serial no from ***Selected list*** section.

Ok: Start of adding selected serial no to backup database.

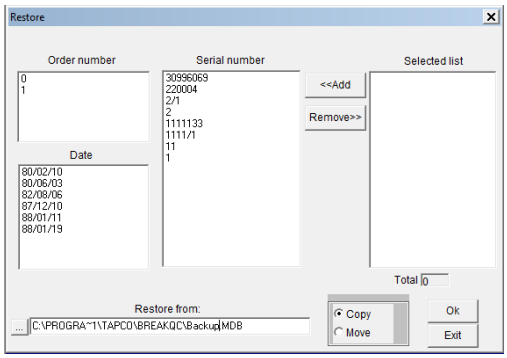
Exit: To close form.

Restore

Menu ***System***, Option ***Restore***

Task:

Transferring information of breaker from backup database to main database to see and change.



Description:

Enter path and name of backup database in ***Restore from*** box. To select database use icon ...

To select a serial number (transfer them to restore check list labeled ***Selected list***) do as follow:

1. Directly selection of one or some serial numbers from ***Serial number*** list. By clicking twice on a serial no, it is added to ***Selected list***. Also if you selected some serial no sequentially (by

holding left button of mouse and move it on serial numbers) You can altogether to select serial number list by clicking on <<Add.

2. To choose a group of serial numbers which have the same order number, by clicking on desired ***Order number*** list, all serial no which have the same order number are selected. Now, add altogether to ***Selected list*** by clicking <<Add.
3. To choose a group of serial number which have the same test date, by clicking on desired date, all serial no tested at that date are selected. Now, by clicking <<Add send altogether to ***Selected list.***

If you want selected serial no not to be deleted from backup database after adding to main database, select ***Copy*** and if you want to delete them after adding to main database, select ***Move***.

If selected serial no exist in main database, user will be informed and if user wants, it is overwritten.

*ⓘName of main database is always **Breaker.mdb**. Restore operation always transfers serial no from backup database to **Breaker.mdb**.*

ⓘIf you have problem in restore from backup database located in CD, copy it on hard and try again.

Buttons:

Add>>: Transferring selected serial no in ***Serial number*** section to restore checklist (***Selected list***) to be added to main database.

<<Remove: Deleting selected serial no from ***Selected list*** section.

Ok: Start of adding selected serial no to main database.

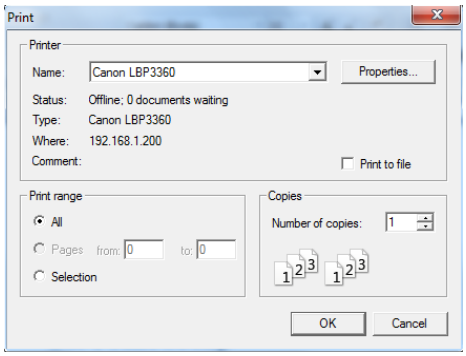
Exit: To close form

Print setup

Menu ***System***, Option ***Print setup***

Task:

Selection and setting printer parameters.



Description:

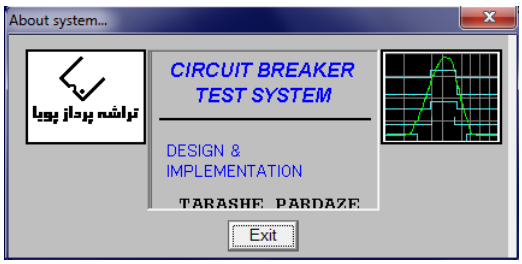
Printer which is determined as default printer in windows will be used in program to print reports. If it is required, you can choose another printer from list of installed printers.

About system…

Menu ***System***, Option ***About system…***

Task:

Displays some information about program



Chapter5- Tables of Breaker.mdb

Changing in each table should be done carefully because any wrong value may effect on system operation. Since some information of a breaker like breaker type, mechanism type, … is saved as order number of them, order of records in tables must not be changed. In other word, in tables which order of records is determined by field ***Index*** or same, amount of this field should not be changed. In tables without this field, order of records appearance should not be changed because of adding a new record or deleting a record. Because of this reason, no record should be deleted from this table, especially when a new record has been defined and it has been saved for a breaker, Unless all information of those breakers are deleted and then those records can be deleted from table.

ⓘIf this database becomes very big, make backup from all breakers in it (transfer them to backup database) and then run program with ***Repair*** *parameter (type it in command line). In this case only* ***System*** *menu will be appeared in program which has* ***Repair database*** *option. Run this option to make database smaller.*

Breaker Constants

Whatever is appeared as different models of breaker in the list in program is extracted from this table. Also, information of physical mechanism of ***Small oil volume, Gas and EDF*** breakers used in calculating contacts motion based on angle of encoder axis turn is saved in this table. In following, fields of this table are described. It is also assumed database is opened in ***Access*** program.

1. Breaker index

It shows the order of appearing models of different breakers in list.

ⓘIt should be mentioned that since in saving information of a breaker, this number is saved as breaker type, it is strongly recommended don't change amount of this field for models which some breakers have been defined.

2. Latin Name, Farsi Name

It recognizes titles appeared as breaker type while printing a curve. For example (***FP*** in following title):

ROUTINE TEST REPORT OF

FP CIRCUIT BREAKER

3. Latin Comment, Farsi Comment

It determines a phrase appeared in front of breaker type (when printing a curve) for ***small oil volume*** and ***Gas.*** For ***EDF*** and ***Vacuum*** breakers, additionally to this phrase, breaker no and electrical specification are extracted from ***Breaker No*** table, ***Comment*** field and will displayed. Total of this phrase will be as breaker type. For example, if breaker is ***small oil volume*** phrase appeared in front of breaker type is:

HL620 (24KV-630A-12.5KA)

And if it is vacuum type, model VD4E with number 20-1210, this phrase will be displayed:

VD4E 20-1210 (12KV-1000A-20KA)

Breaker Type

It shows all models of breaker accessible for user to be selected in program. This field is used to show a list of different models of breaker in ***Get Breaker Specification*** form and ***Tolerance*** form.

1. **Theta1, Theta2, e, L,R**

It Shows information of physical mechanism of ***small oil volume***, ***Gas*** and ***EDF***.

2. **Breaker Category**

This is a code that indicates breaker type. For ***small oil volume*** is 0, for ***Gas*** is 1, for ***EDF*** is 2 and for ***Vacuum*** is 3.

Adding a new record:

Adding a new record to this table means adding a new breaker model. To do, make an empty record. Put ***Breaker index*** field one more than amount of it in last record. Enter title for breaker type when printing and also information of physical mechanism according to breaker feature. Give quantity to ***Breaker category*** field based on breaker type of new model.

ⓘBased on this new model, a suitable record should be added to ***Tolerance Of Parameters*** *table.*

Breaker no

Some breaker like ***EDF*** and ***Vacuum***, addition to model has a number too which determines electrical features of breaker. These numbers are kept in this table. Some fields of this table introduced here:

1. **Index**

It shows order of appearance of numbers in list in software.

ⓘAs mentioned before, for records defined before or added next and save breakers with this new record, field amount should not be changed. No record should be also deleted.

2. **Comment**

It determines a phrase appeared in front of breaker model according to each number (as electrical features of breaker).

Adding a new record:

Add a new empty record to table. Put ***index*** field one more than amount of it in last record. Determine other fields arbitrary.

Breaker settings

Test settings of each breaker model are in this table. That is appeared in ***Breaker settings*** form are based on this table. Some fields of this table are introduced here:

1. Latin Breaker Name, Farsi Breaker Name

It determines all types of breaker title appeared in ***Breaker settings*** form. This field divides breakers to four groups: ***Small oil volume***, ***Gas***, ***EDF*** and ***vacuum***.

2. Breaker category

This is a code that indicates breaker type. For ***small oil volume*** is 0, for ***Gas*** is 1, for ***EDF*** is 2 and for ***Vacuum*** is 3.

For other fields, regarding to its name, its task is clear.

*ⓘRegarding to this point that **Circuit Breaker Test System Ver1** and upper is designed only for above four breaker types, to add a new record (new breaker type) contact TAPCO.*

Captions

Appeared titles in ***Get Breaker Specifications*** form are achieved from this table. By clicking twice on each title, you can change it. Titles are based on breaker type. So, you can define independence and separate title for each breaker. Some fields are described here:

1. Breaker category

This is a code that indicates breaker type. For ***small oil volume*** is 0, for ***Gas*** is 1, for ***EDF*** is 2 and for ***Vacuum*** is 3.

2. ID

For each title a number is specified which has 5 digits. First 2 digit (left ones) are always **01** but 3 next digits are order of title which is started from **000** and for each title is incremented by 1.

*ⓘFor each breaker type, order of title should be started from **000**.*

3. Latin Caption, Caption

Orderly it shows English and Persian title.

4. Default Latin Caption, Default Caption

Orderly, it shows English and Persian title that user can select it as current phrase for desired title by pressing ***Default*** button in ***Change title*** form (which is appeared after double clicking on title).

ⓘBecause order and number of titles in program are fixed, never change number of records and records order.

*ⓘAfter changing a title, care about the way of appearing it in **Get Breaker Specifications** form.*

Mechanism Types

Kinds of mechanism appeared in ***Get Breaker Specifications*** form are extracted from this table.

ⓘAs mentioned at the first of this chapter, order of records in this table must not be changed because based on this order, information of breaker mechanism type is saving. Order of 3 records in this table is BLRM, BLR and FSA1-F. Therefore, if any record is added to this table, be careful previous records order doesn't change.

Message Bank

Appeared messages in program are extracted from this table.

ⓘNever change anything in this table.

Operator

It shows information about users. Any changes in this table should be done through program (***Operators information*** option).

Result Data

Information of run maneuvers is kept in this table. Avoid any changes in this table because it ruins information of maneuvers.

Result Header

Information of breaker is saved here.

Shassi Types

All case types (***Chas type*** list) in ***Get Breaker Specifications*** form are achieved from this table.

Standard Types

All standard types (***Standard*** list) in ***Get Breaker Specifications*** form are achieved from this table. Two standards **IEC60056** and **ANSI** are used to calculate minimum and maximum voltage of coils and motor from nominal voltage automatically.

*ⓘTo describe more refer to **Appendix1**.*

Test Phrase

Phrases of maneuvers are kept in this table. These phrases are appeared in ***Routine Test*** page in ***Get Breaker Specifications*** form and also as maneuver title in printing curves.

Tolerance of Parameters

The measures used in ***Tolerance*** form are extracted from this table. In following, you can see some fields.

1. **Breaker category**

This is a code that indicates breaker type. For ***small oil volume*** is 0, for ***Gas*** is 1, for ***EDF*** is 2 and for ***Vacuum*** is 3.

2. **Breaker Index**

It shows the order of titles related to breaker types.

3. **Breaker Type**

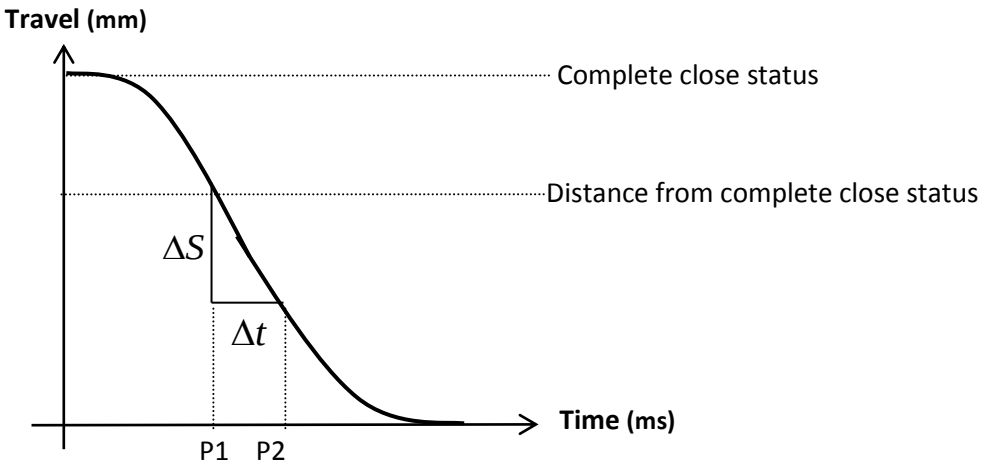
It shows breaker title. This field only helps user to recognize each records specified for each breaker.

ⓘIf you add a new breaker model to breaker constants table a suitable record for that breaker should be added to this table, too.

Appendix1- The method of calculating Parameters

Close/ Open Speed

1. **Small oil volume type- Open maneuver**

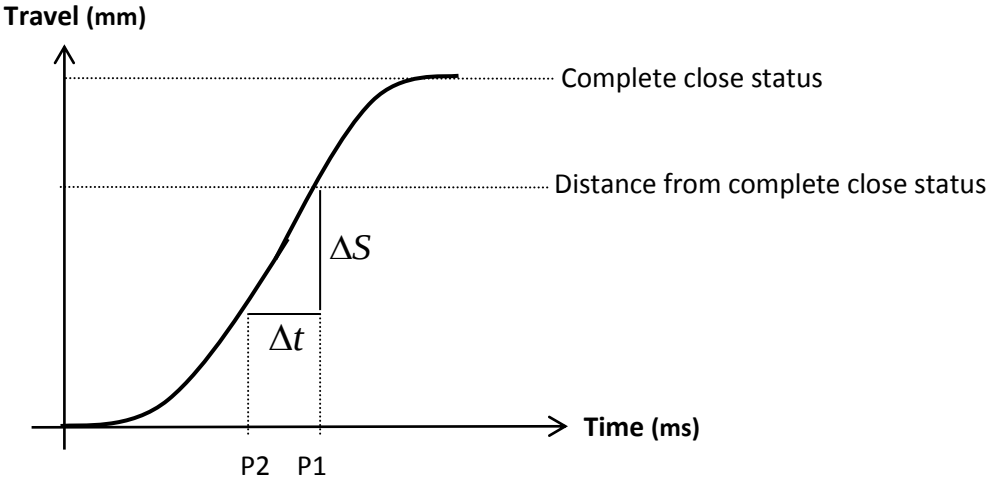


P1: it is the time that motion difference (course) with complete close status (sample in start of maneuver) is equal to (or the nearest value to) determined distance in ***Breaker Settings*** form as ***Distance from total travel***.

P2: it is extracted from ***Duration time for open speed*** which is determined as this title in ***Breaker Settings*** form. Speed is calculated from this formula:

$$V = \frac{\Delta S}{\Delta t}$$

2. **Small oil volume- Close maneuver**



P1: it is the time that motion difference (course) with complete close status (last sample) is equal to (or the nearest value to) determined distance in ***Breaker Settings*** form as ***Distance from total travel***.

P2: it is extracted from ***Duration time for close speed*** which is determined as this title in ***Breaker Settings*** form. Speed is calculated from this formula:

$$V = \frac{\Delta S}{\Delta t}$$

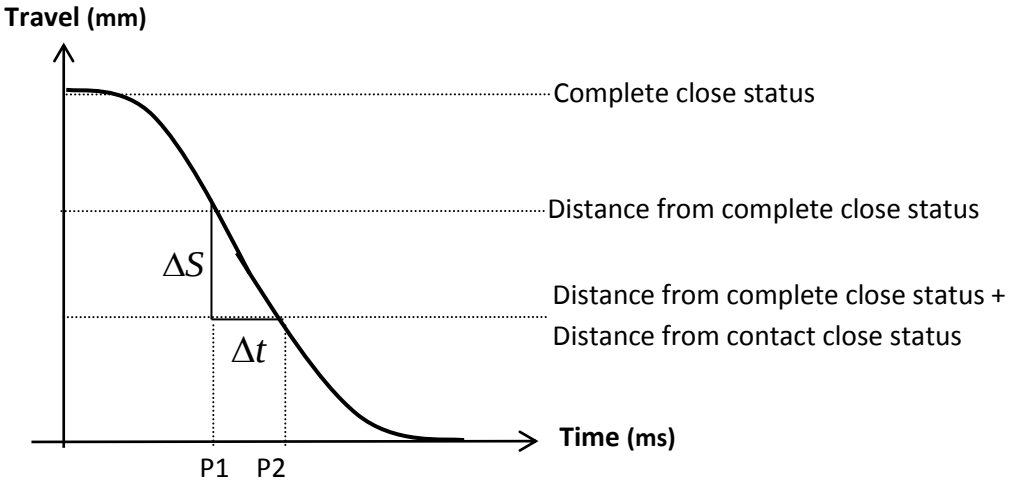
3. **Gas type- Open/ Close maneuver**

It is the same as ***small oil volume*** breakers but distance from complete close status is always half of the total motion and because of that, in ***Breaker settings*** form there is no setting for gas type titled ***Distance from…***. But ***Duration time for close (or open) speed*** settings exists.

4. **EDF type- Open/ Close maneuver**

It is exactly like ***small oil volume*** breakers.

5. **Vacuum type- Open maneuver**

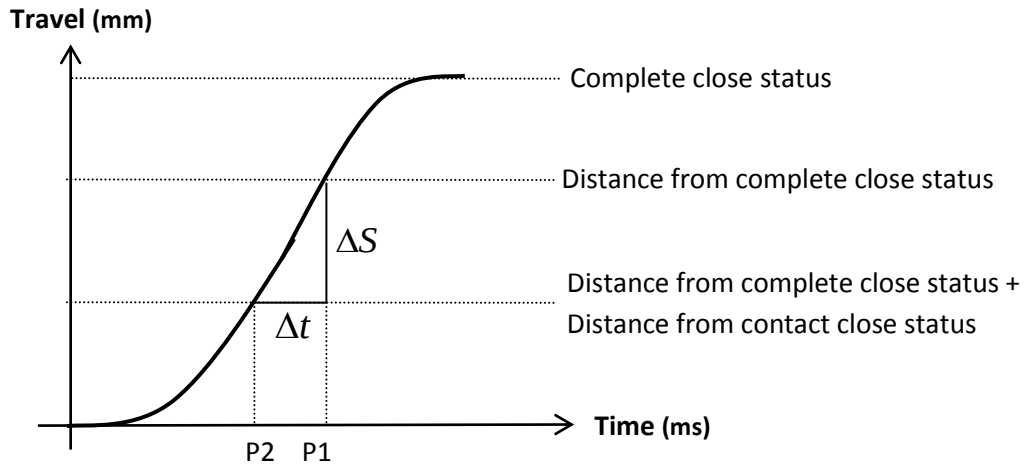


P1: it is the time that motion difference (course) with complete close status (sample in start of maneuver) is equal to (or the nearest value to) determined distance in ***Breaker Settings*** form as ***Distance from total travel-open***.

P2: it is the time that motion difference (course) with complete close status (sample in start of maneuver) is equal to (or the nearest value to) total distances determined in ***Breaker Settings*** form as ***Distance from total travel-open*** and ***Distance from contact travel-open***. Speed is calculated from this formula:

$$V = \frac{\Delta S}{\Delta t}$$

6. **Vacuum type- Close maneuver**



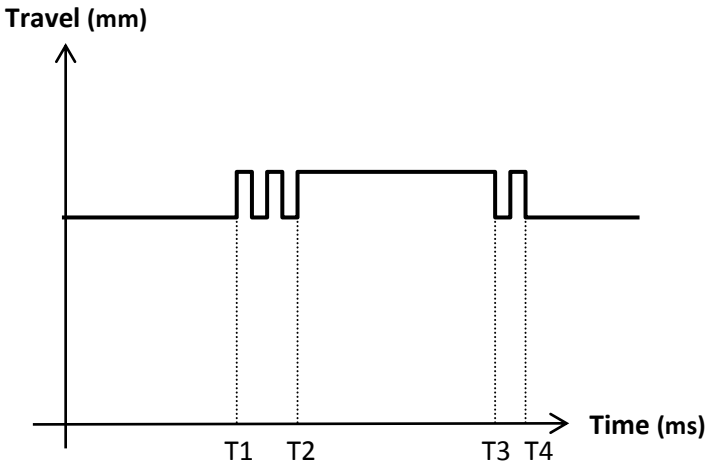
P1: it is the time that motion difference (course) with complete close status (last sample) is equal to (or the nearest value to) determined distance in ***Breaker Settings*** form as ***Distance from total travel-close***.

P2: it is the time that motion difference (course) with complete close status (last sample) is equal to (or the nearest value to) total distances determined in ***Breaker Settings*** form as ***Distance from total travel-close*** and ***Distance from contact travel-close***. Speed is calculated from this formula:

$$V = \frac{\Delta S}{\Delta t}$$

Contacts Operation Time and Contacts Duration Time

Suppose that operation of a contact is as following diagram:

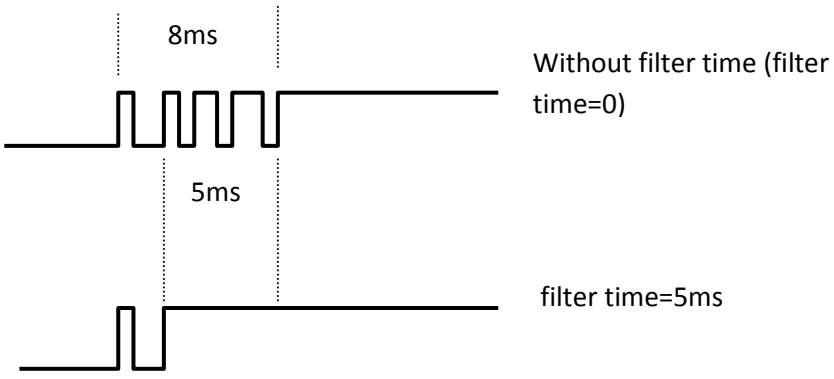


To calculate contact operation time following formula is used:

Top=T3-T1

In other words, the first operation time is assumed (regardless to bounces).

Setting of filter time in ***Breaker settings*** form only effect on display. Below diagrams show displaying contact operation curve in two different filter time settings:



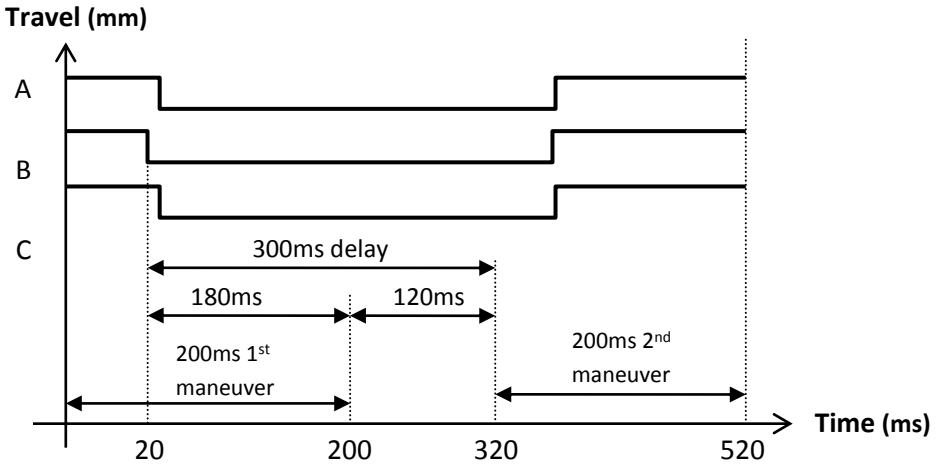
Method of applying delay in multi stage maneuvers including delay

After one of main contacts operates, applying delay will started. After completing first stage of maneuver, remaining time of delay (if it is remained) will be added (applied) and then maneuver will be continued.

Example: Maneuver ***Open-Delay-Close*** with following settings (***Breaker settings*** form):

Sample duration in each phase=200ms

Delay time in open close=300ms

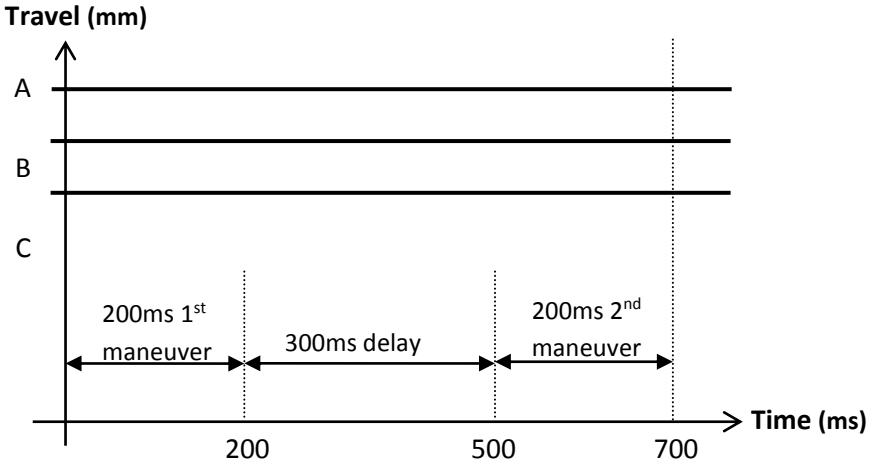


If no ones (main contacts) operate, delay will be applied after completing first stage of maneuver.

Example: Maneuver ***Open-Delay-Close*** with following settings (***Breaker settings*** form):

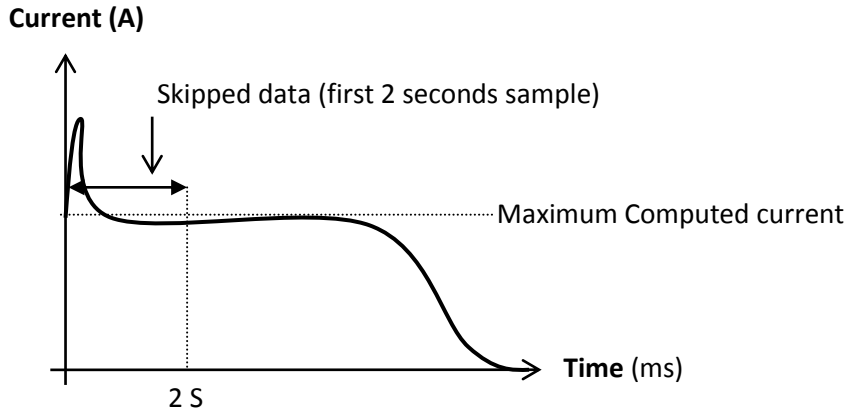
Sample duration in each phase=200ms

Delay time in open close=300ms



Maximum motor current

To omit primary current peek, searching maximum motor current is done by skipping first 2 seconds of samples. See bellow diagram:



Spring charging time

1. **Vacuum breakers**

When motor current is 70% of maximum current (according to above method), it is assumed motor has been turned off and thus charge of spring has been finished too.

2. **Other than vacuum breakers**

It is like vacuum breakers only instead of 70%, 20% is considered.

Point speed

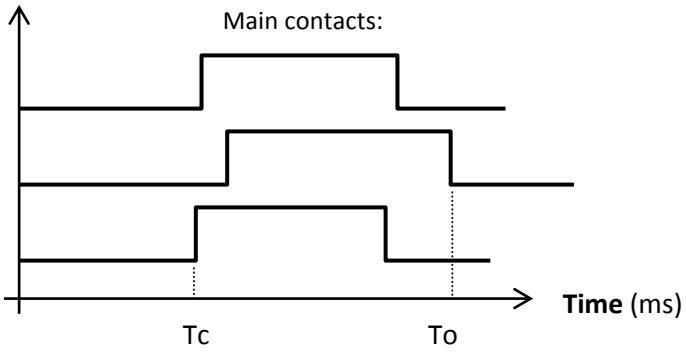
By putting mouse on each point of motion curve, its speed is calculated as follow formula:

8 dots backward and 8 dots forward are taken into account and speed is calculated for every two sequential dots. Eventually, mean of these speeds is displaying as speed of desired point (mouse position).

Open/ Close operation time

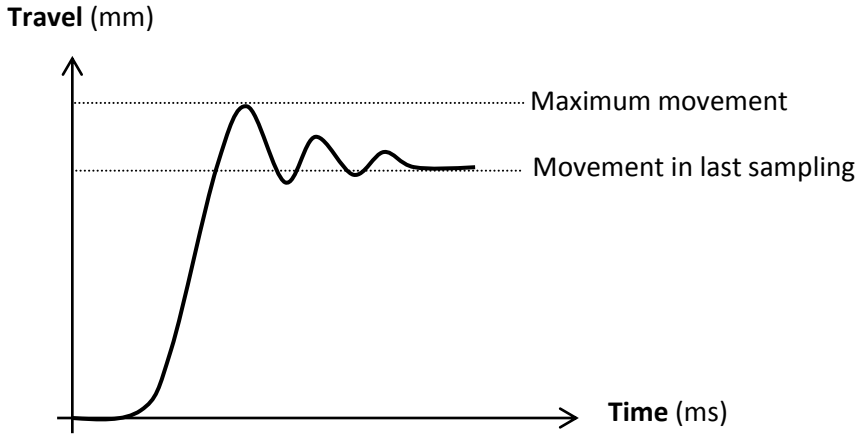
1. **Close:** Operation time of first closed contact (of main contacts) is considered as close time of contact.
2. **Open:** Operation time of last opened contact (of main contacts) is considered as open time of contact.

In bellow diagram, Tc is close time and To is open time.



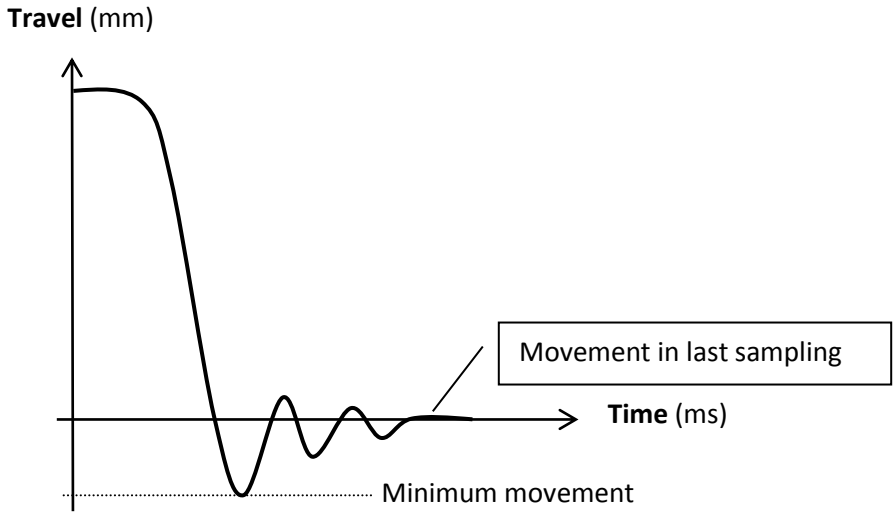
Over Travel

1. **Close maneuver**



Over travel= Maximum movement - Movement in last sampling

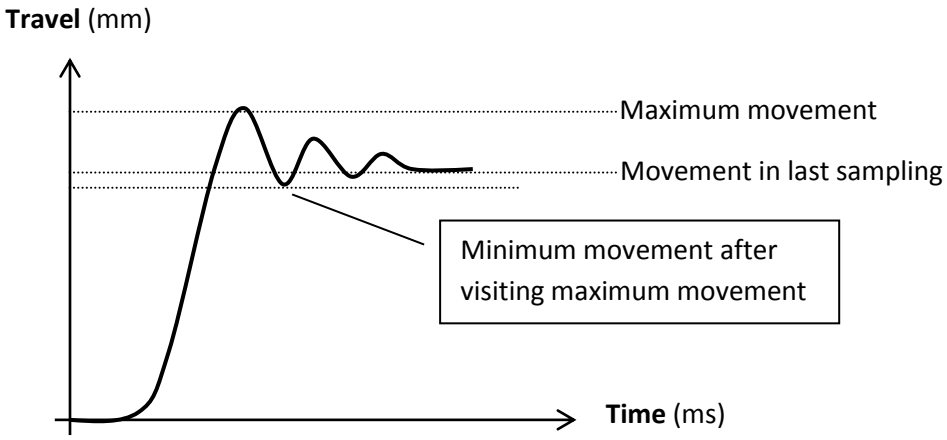
2. **Open maneuver**



Over travel= Movement in last sampling - Minimum movement

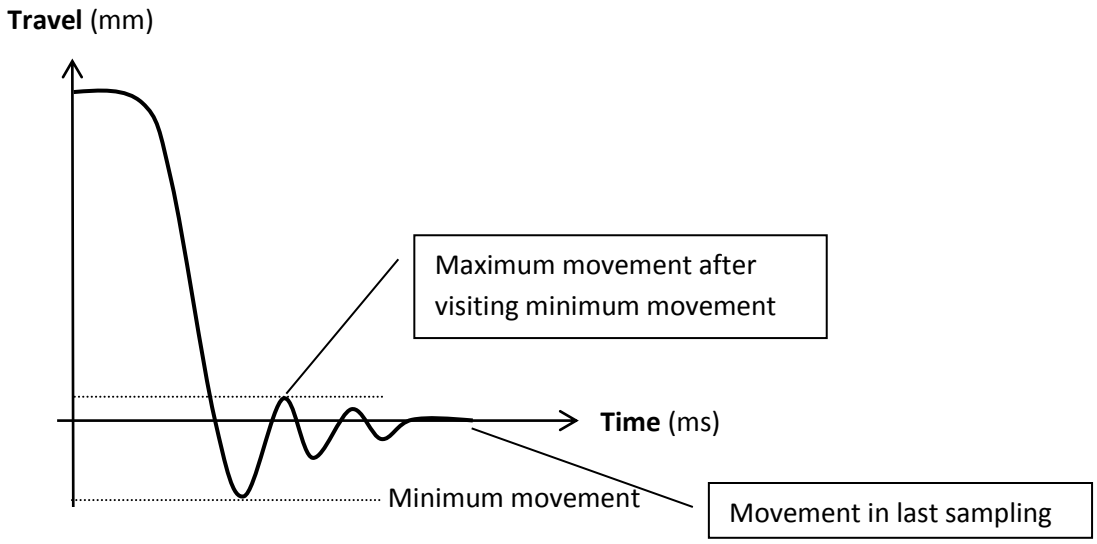
Rebounce

1. **Close maneuver**



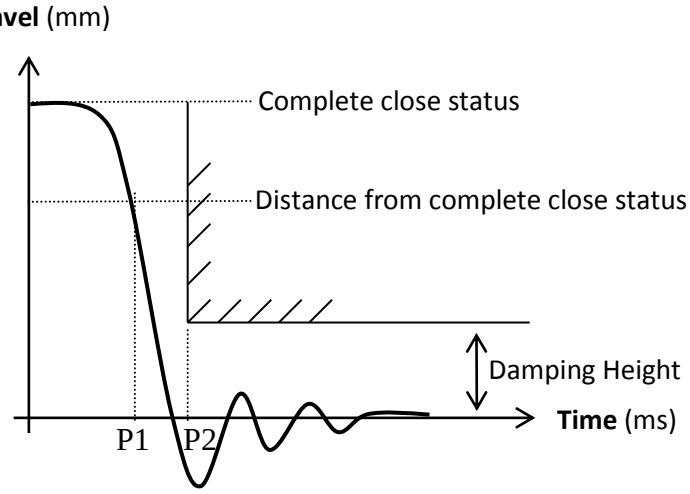
Rebounce= Movement in last sampling - Minimum movement after visiting maximum movement

2. **Open maneuver**



Rebounce= Maximum movement after visiting minimum movement - Movement in last sampling

Damping line



First, time of P1 is achieved. Then this time is added to ***Damping time*** determined in ***Breaker settings*** form to achieve P2. Now draw a vertical line in P2 and a horizontal one in ***Damping height*** distance (determined in ***Breaker settings*** form).

ⓘPay attention that damping line is meaningful only in open maneuver.

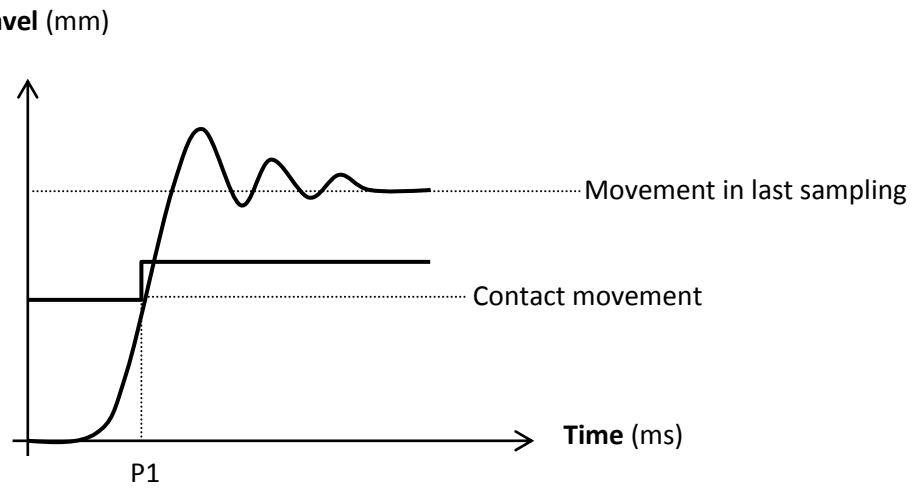
Total contact movement

For vacuum breakers and non vacuum breakers total movement is calculated:

Total travel= Absolute of **(**Movement in first sampling - Movement in last sampling)

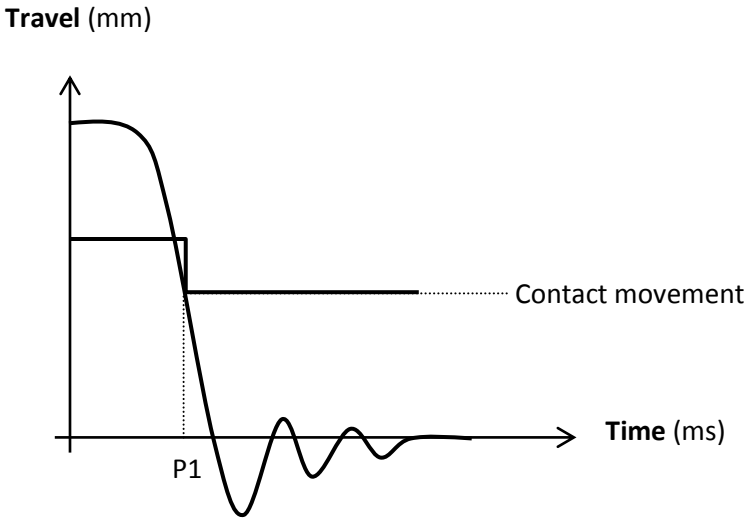
Contact movement in vacuum breakers

1. **Close:** in this diagram you can see motion curve of a contact with its operation (to be closed contact). Contact movement is calculated:



Contact movement= absolute of (Movement in first sampling - Movement in close time of contact)

2. **Open:** in this diagram you can see motion curve of a contact with its operation (to be opened contact). Contact movement is calculated:



Contact movement= absolute of (Movement in last sampling - Movement in open time of contact)

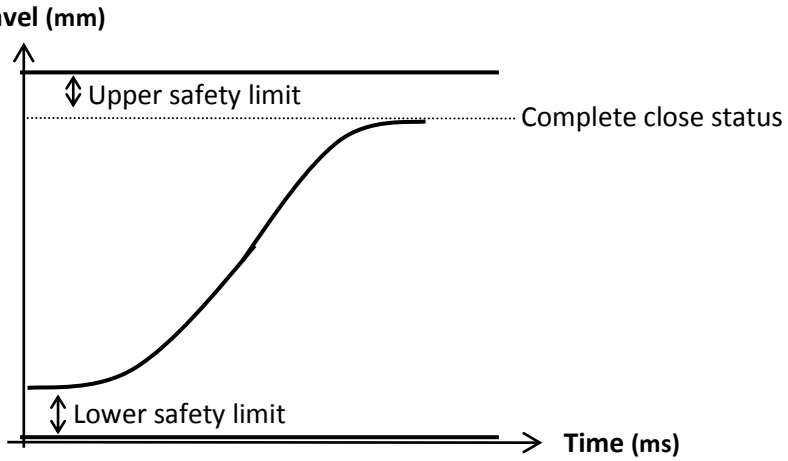
Contact spring movement

In open or close maneuver is equal to:

Contact spring movement= Total movement – Contact movement

Safety limits

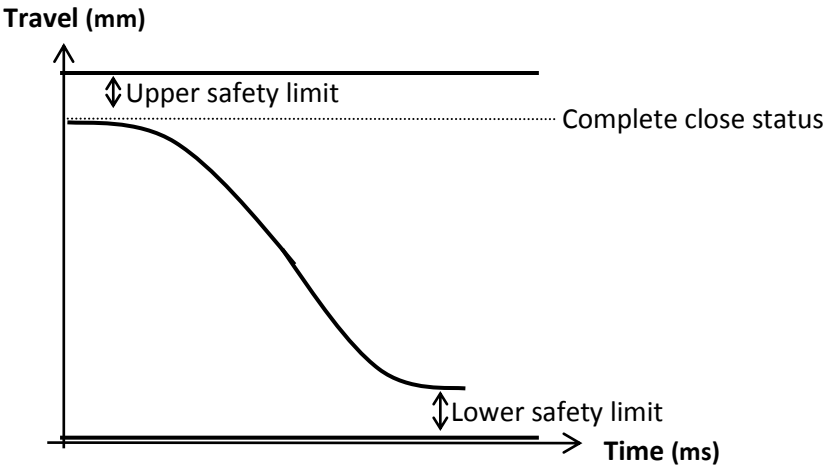
1. **Close maneuver**



Lower safety limit= Movement in first sampling – Minimum contact movement without mechanism

Upper safety limit= Maximum contact movement without mechanism - Movement in last sampling

2. **Open maneuver**



Lower safety limit= Movement in last sampling – Minimum contact movement without mechanism

Upper safety limit= Maximum contact movement without mechanism - Movement in first sampling

Minimum voltage of coils operation

1. Testing breaker status regarding to selected coil. If breaker status is not proper (for example, close coil has been selected and breaker is coin close status too) proper maneuver will be applied to breaker to change breaker status.
2. Position of tester relays is put on AC.
3. Power supply is put on a percent of nominal voltage determined in ***Constant settings*** form. If power supply is handy, user should do this. Power supply voltage should be stayed fix in this voltage to continue function (2 volt tolerance isn't important).
4. Suitable maneuver command is applied on breaker considering to selected coil.
5. If breaker operates, this voltage is **minimum voltage of coil operation**. Otherwise:
6. Power supply voltage is increasing gradually with respect to ***Voltage step*** box in ***Constant settings*** form.

7. If power supply voltage goes upper than maximum permitted limit, process will stop and a message comes up to show lack of correct operation of coil. Otherwise, operation is continued from stage4.

Maximum and minimum voltages for coils

	Standard IEC56		Standard ANSI	
	Minimum	Maximum	Minimum	Maximum
Motor/ Coil- AC	85%*	110%	85%	110%
Motor/ Close Coil- DC	85%	110%	72%	112% **
Open Coil- DC	70%	110%	56%	112% **

*: it means 85% nominal voltage

**: if in DC voltage and ANSI standard, nominal voltage is lower than 100V, coefficient of 112% is converted to 117%

Under voltage relay test in close status

1. Breaker status test is done. If it is not proper (it is open), a close maneuver will be applied. If breaker become close:
2. Tester relays is set to AC.
3. Power supply is set to nominal voltage of relay.
4. Dedicated command for testing this relay will be sent to tester.
5. Power supply is read.
6. If breaker is open, this voltage is recorded as operation voltage for under voltage relay in close status and test is finished. Otherwise:
7. Power supply voltage is decreased with determined speed by user in ***Constant settings*** form and above action is repeated.
8. If voltage become lower than 10 volt, it means under voltage relay doesn't work correctly. An error message will be displayed.

Under voltage relay test in open status

1. Breaker status test is done. If it is not proper (it is close), an open maneuver will be applied. If breaker become open:
2. Tester relays is set to AC.

3. Power supply is set to 20 volt.
4. ***Power supply*** form will be opened (including ***Ok*** button).
5. Now, user can change voltage in this form. When relay operates, voltage can be recorded by pressing ***Ok*** button.

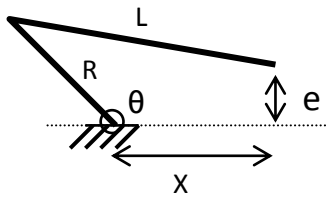
Blocking coil current

1. Breaker status test is done. If it is not proper (it is close), an open maneuver will be applied. If breaker become open:
2. Tester relays is set to AC.
3. Power supply voltage is set to nominal voltage of blocking coil.
4. Dedicated command for testing this coil will be sent to tester.
5. Delay (6 seconds) is applied to gathering information of blocking coil current.
6. These data is read from tester and mean of last 10 data is recorded as blocking coil current.

Anti pumping relay

1. Breaker status test is done. If it is not proper (it is open), a close maneuver will be applied. If breaker become close:
2. Form of setting motor and coils voltage is appeared. After setting voltages, close-open maneuver with determined delay in ***Constant settings*** form is applied to breaker.
3. If breaker doesn't become open an error message will be appeared and test is stopped. Otherwise:
4. 6 seconds delay is applied until information is gathered. After spending this time, breaker status is read. If it is close, error message is appeared and test is stopped. Otherwise (breaker is open yet) message indicating correct operation for anti pumping relay will appeared.

Calculating movement from turning angle of encoder



$$X = -RCos\theta + \sqrt{L^2 - (RSin\theta - e)^2}$$

Calibration coefficient for power supplies

For voltages 70, 128, 160 and 200 volt following operations are done:

1. Power supply voltage is set to desired voltage.

2. Voltage is read from tester in 6 seconds and calibration percent is calculated and displayed from this formula:
   Calibration= set voltage / read voltage

3. Mean of read voltages in last 2 seconds are considered as power supply voltage and base on above formula, calibration percent is calculated and recorded.

Appendix2- Error Messages

Some error message appeared during working with program are described here:

1. **Sampler.ini not found:** After installing program and running it for first time, this message is appeared and program settings are set to defaults. The most important settings exist in ***Constant settings*** form and ***Calibration coefficients*** form. Therefore, before doing anything, determine these settings correctly.
2. **You cannot change breaker type when breaker has been tested:** Before changing breaker type, you have to delete all done maneuvers of that breaker.
3. **Error in serial port, it may be locked by another device:** Determined port no has been used by another device. Run ***Serial port test*** option from ***Operation*** menu to set connected serial port no to tester.
4. **Communication error:** Computer cannot connect to tester. There is something wrong such as tester is off, tester is not in main page or cable is spoiled. By using facilities in ***Serial port test*** form (and especially **loop back connector**) you can fix problem.
5. **Port serial may crash:** if tester is on, turn it off and then turn it on again.
6. **Database is corrupted, please don't use it:** Database name is fix ***Breaker.mdb*** and its location is program install folder.
7. **Serial port is working, disconnect it at first:** When computer and tester are exchanging information, you cannot open other forms. So, it is needed first closing serial port connection. It is possible by clicking ***Cancel*** button in active form.

*ⓘIn **Sensors and contactors** form, **Cancel** button doesn't exist and you must close form to stop serial connection.*

8. **Database cannot be opened, it is better to delete it:** do as it is said for error **Database is corrupted, please don't use it.**
9. **Database for … is empty:** it shows a problem in related table of database. If possible, remove the problem. If not, do similar to error **Database is corrupted, please don't use it.**
10. **Name of backup database is the same as name of main database:** name of backup database cannot be ***Braeker.mdb***
11. **Close open forms and try again:** close open forms and try again. If the problem wasn't fix, close program and run it again.
12. **Power supply output may not cut:** after sending command for turning power supply off if no response wasn't receive from power supply, output voltage of power supply may not cut and user must care about it.
13. **Power supply output doesn't become cut:** after sending command for turning power supply off if output voltage doesn't decrease at least 20 volt, this error is appeared.

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