

Circuit Breaker Test System

Hardware Version 4 (Portable)

User manual

Produced by

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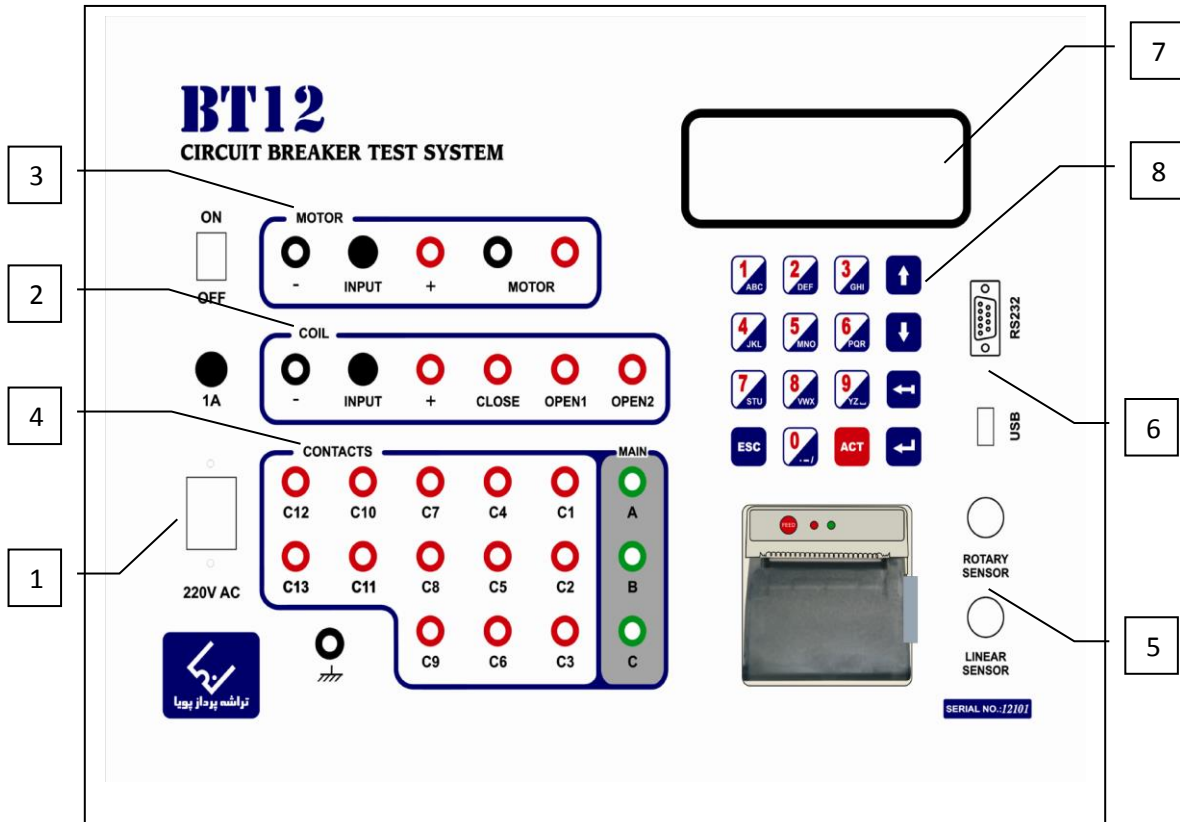
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Chapter1- General features

Characteristics

- Sampling frequency from considered inputs is 10KHz
- Contains one increasing encoder input and one linear sensor input
- Ability to save up to 96 test results in internal memory and transferring to PC
- Ability to print test results
- Two voltage inputs for coil and motor for measuring (no difference between AC and DC)
- Ability to measuring and sampling from coil and motor current
- 16 inputs for contacts
- Exciting one close coil and two open coils
- Connecting to two power supply type: handy and controllable made by TAPCO
- Connecting to PC via serial port and USB

Chapter2- Top Panel



There are collections of connectors, input and output safety connectors, keyboard and screen display on BT12. Each of those is in separate groups and has their own task which is explained in the following:

1. 220V AC supply

Input connector 220V AC is installed here. This connector has a pin to connect to the ground which has to be connected to the ground. There is an ON/ OFF key, also. Its fuse is 1A and it is above the connector.

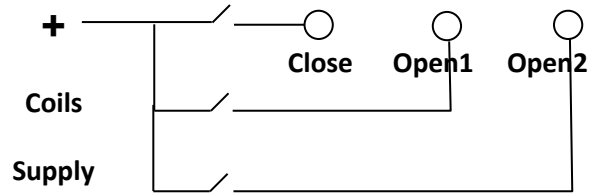
ⓘ Notice that ground pin must be connected to the ground while testing. To do so, you can use the safety connector that is next to the supply connector.

ⓘ ON/ OFF key just connects/ disconnects 220V AC and is not related to coil or motor power supply.

ⓘ It is better that coil and motor power supply be off when BT12 is off and also, first turn on BT12 then motor and coil power supply.

2. COIL

In this group open and close safety connectors for coils supply are installed. Two safety connectors with label **INPUT** are supply input. This input supply goes to a board and is connected from there to **CLOSE**, **OPEN1** and **OPEN2** safety connectors. Thus, BT12 excites those coils in needed moment.



Red safety connectors are positive pole of supply.

Fuse of this group is 10A.

3. MOTOR

In this group safety connectors of required supply to excite motor are installed. Motor supply is entered to BT12 via 2 safety connectors with label **INPUT** and will connect to safety connectors with label **MOTOR** and motor is excited by these safety connectors.

Red safety connectors are positive pole of supply and black safety connectors are negative pole of supply.

BT12 doesn't control on motor supply at all and motor turns on as soon as supply is connected to BT12 and turns on.

Fuse of this group is 10A.

4. CONTACTS

They are used for connecting contacts on breaker to BT12 for sampling their operation status. Safety connectors are labeled from A to C13. To connect 3 main contacts of breaker to BT12, you must connect A, B and C to bottom of breaker main contacts. Other contacts (auxiliary contacts) must be connected to C1 to C13.

Other side of contacts (top side) must be connected to the ground.

While connecting contacts cable, be careful they don't short circuit to other parts of breaker which have probably voltage.

5. SENSORS

To connect different sensors to BT12 use connectors located here. Connector labeled **LINEAR SENSOR** is to connect linear sensor and connector labeled **ROTARY SENSOR** is to connect encoder.

*Explanation of these connectors are in **Chapter4**.*

6. SERIAL CONNECTORS

BT12 is connected to computer via these two ports:

- Serial port adjusted to standard RS232
- USB port



*①Explanation of RS232 connector pins are in **Chapter4**.*

7. LCD

LCD has characters in 4 rows in 20 columns with back light.

8. KEYBOARD

To do different operation, there is a keyboard with 16 keys on BT12. Keys are as follow:

- 0 to 9: to enter digits or letters and also, to choose different menu appeared on screen.
- ENTER : to confirm
- ARROW: to move on different rows appeared on screen.
- ESC: to exit from present status to previous one. For example return to main page from breaker test page.
- SHIFT : to do some special operation. It will be explained later.
- ACT: in breaker test page, after selecting a test this key must be pressed to apply proper maneuver to breaker. If this key is pressed directly (without selecting a test), open or close maneuver (each is actable) will apply to breaker.

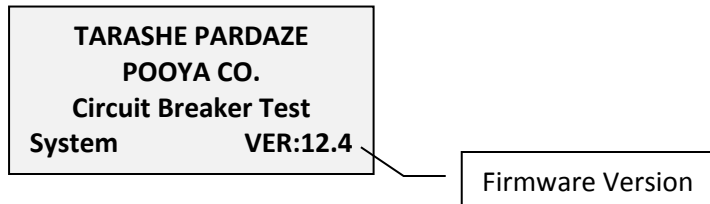
*①In main page and breaker test page, if **0** is pressed, active coil is switched between 1 and 2.*

Chapter3- Using BT12

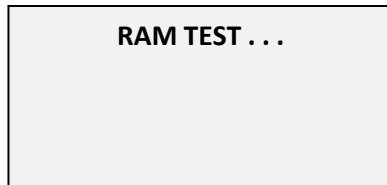
Preparing BT12

Preparing BT12 needs following stages:

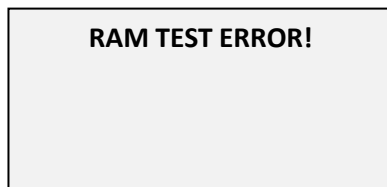
- After turning BT12 on following message appears on screen:



- In this stage RAM TEST... message appears and correctness of internal memory of BT12 is investigating:

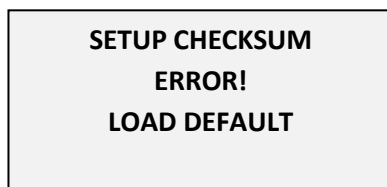


If there is a problem, this message appears and BT12 stays in this status:



ⓘ If this problem happens, contact TAPCO.

- If internal memory of BT12 is correct, information of BT12 settings (setup) is investigated. In this stage, if BT12 settings are going wrong in any reason (for example, dropping of backup battery voltage), following message appear and default values are saved for settings.



- In this stage, message **SAVED TESTS...** appears and correctness of information of saved tests are investigated:

```
RAM TEST . . .  
SAVED TESTS . . .
```

If in information of saved tests there is a problem, this page appears:

```
RAM TEST . . .  
SAVED TESTS . . .  
LOC:01 Error!  
Delete? <ENTER>
```

Test number that its information has wrong values is shown in front of statement **LOC:.** By pressing **ENTER** key you can delete this wrong test. By pressing any other key, test won't be deleted and investigating of saved tests will continue.

*ⓘ By pressing **ESC** key, investigating of correctness of saved tests is canceled.*

ⓘ If you don't delete a wrong test, you may meet wrong data when browsing saved tests.

- After above stage, **RTC TEST...** message appears and correctness of internal time of BT12 is investigating:

```
RAM TEST . . .  
SAVED TESTS . . .  
RTC TEST . . .
```

If internal time of BT12 has problem, following form appears:

```
RAM TEST . . .  
SAVED TESTS . . .  
RTC ERROR!
```

And after a few seconds BT12 internal time setting form appears and you can correct the time.

*ⓘ Refer to **Internal Time of BT12** for more information.*

After passing above stages, main page appears as follow and BT12 is ready to operate:

87/01/17	15:27:19
1>BR. TEST	2>D. TEST
3>MEMORY	4>SETUP
COIL: 110 V	

In first row, internal date and time of BT12 is shown. In main page these operations are selectable:

- Click on one of keys 1, 2, 3 and 4 to enter to other pages.
- Click on ↑ to see voltage and current of motor.
- Click on ↓ to see voltage and current of coil.
- Click on 0 to select open1 or open2 as active coil to open breaker.

Breaker test page

To enter to this page, click on key 1 in main page. Following screen appears:

1>CLOSE	2>OPEN
3>CO	4>O-T-C
5>C-T-O	6>O-T-CO
7>CONTACT	8>TIME CL

In this page following operations are executable:

- Clicking on one of keys 1 to 6 to do a test (maneuver).
- Clicking on key 7, to see contacts status.
- Clicking on key 8, to see changing time of contacts
- Observing breaker status at the bottom of page on the right: **OP** means breaker is open, **CL** means breaker is close.

ⓘ Breaker is close when at least one of main contacts is close and it is open when all of main contacts are open.

By pressing one of keys 1 to 6, one of following maneuvers is selected:

1. Close
2. Open
3. Close-Open (CO)
4. Open-Delay_Close (O-T-C)
5. Close -Delay_Open (C-T-O)
6. Open-Delay_Close -Open(O-T-CO)

Doing a test (applying a maneuver)

To do a test, choose desired test no (one of keys 1 to 6). If test isn't valid to apply to breaker, for example selected test is **Close** and breaker status is **Close** too, below message appears:

**TEST IS NOT
APPLICABLE!**

PRESS ANY KEY . . .

If selected test is valid to apply to breaker this message will be appeared:

**TEST NAME
CLOSE**
PRESS "ACT" KEY!

Selected test

By clicking **ACT** key, necessary commands are sent to breaker's coils and desired test is run. After completing test, results (time test results) are displayed in some pages.

Time test results pages

- **First page:**

OUT OF SYNC: 0.9ms

ACT>Save test **3>Prn**

In this page, out of synchronizing of breaker poles (main contacts) are shown.

*By clicking **ACT** key, done test is saved.*

*By clicking key **3**, results could be printed.*

To go to next page of test result, press ↓. Following page appears:

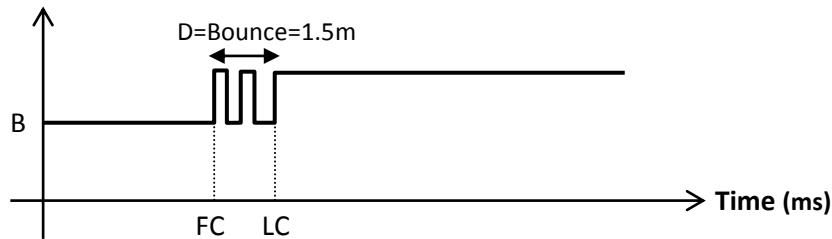
- **Second page:**

	FC	LC	D	ms
A:	23.5	23.5	0.0	
B:	22.9	24.4	1.5	
C:	23.8	23.8	0.0	

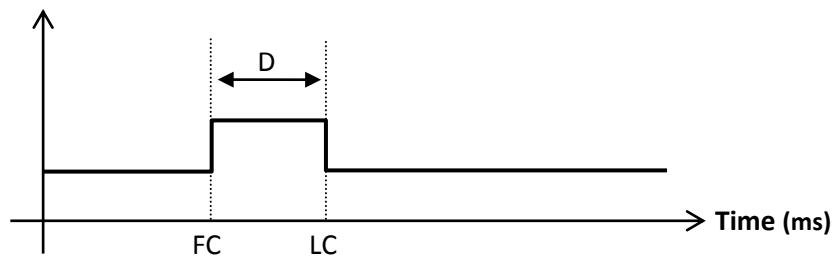
In each row, operation time of a contact is shown.

First time is time of first change in contact status labeled **FC**. Second time is time of last change in contact status labeled **LC**. Third time is difference between LC and FC labeled **D** (Difference).

If above times are result of a single **Close** maneuver, $D=1.5\text{ms}$ for contact **B** shows that this contact has been 1.5ms bounce while close.



As another example, below diagram shows contact **B** operation in simultaneously **Close-Open**. In this case, **D** shows time duration of contact **B** activation.



To go to next page of test result, press ↓. Following page appears:

- **Third page:**

C1:	0.0	0.0	0.0
C2:	0.0	0.0	0.0
C3:	0.0	0.0	0.0
C4:	0.0	0.0	0.0

Numbers shown in this page come after previous page and results are related to contacts **C1**, **C2**, **C3** and **C4**.

To go to next page of test result, press ↓. In this manner, time test result of other contacts in next pages are shown.

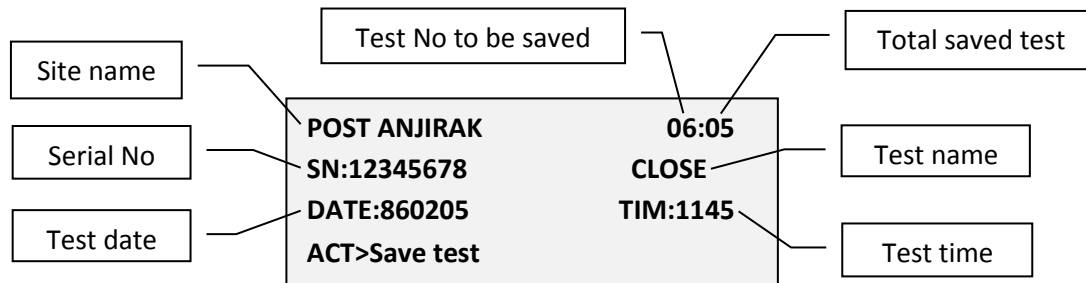
① In every above page, go back to **Breaker Test** page by clicking **ESC** key.

① To move on different pages of test results, use ↓ and ↑.

① When you are in **Breaker Test** page and want to see time test result of last executed maneuver, press **Shift** key.

Saving done test

By clicking **ACT** key in page1 of time test result page, this page will be appeared:



ⓘ **Time test result** page is activated in two ways: Automatically after doing a test, by clicking **Shift** key in **Breaker test** page.

By clicking ↓ and ↑ you can move between different fields and enter characteristic of tested breaker:

- Enter name of site where test is done in **Site name** field (maximum 14 characters).
ⓘ See **Typing letters** section to more information about typing letters.
- Number of first empty memory location is suggested in **Test No to be saved** field. You can change this number between 01 to 96. If a test has been saved in this location before, it will be over written.
- You can enter breaker serial number in **Serial No** field (maximum 8 characters). It is noticeable that this number must be identical for all tests of a breaker.
- Date of test is extracted from internal RTC of BT12 and puts in **Test date** field automatically.
- Time of test is extracted from internal RTC of BT12 and puts in **Test time** field automatically. Note that this field doesn't save in computer but it is useful for indicating priority of tests.

ⓘ **Test date** and **Test time** cannot be changed.

ⓘ to delete typed characters, press **Shift**.

By pressing **ACT** key entered information will be saved in BT12 memory.

ⓘ If **Test No to be saved** field isn't valid, test will not be saved. If a test has been saved before, message **OVERWRITE? <ENTER>** will be displayed and test will be saved only by pressing **Enter** key.

Typing Letters

On numeric keys, there are letters too. When typing a statement in a field (like **Site name**) following rules are applied:

- When a key is pressed for the first time, letters related to that key is appeared at the bottom of LCD on the right. If you repress the same key before passing 1.5 second, cursor goes to next letter. This action is done circularly.

- If no key is pressed for 1.5 second, last selected letter (the letter that cursor is on it), will be entered into field.
- If another key (containing letters) is pressed before passing 1.5 second, at that time last selected letter will be entered and letters of new key are shown on LCD.
- If **Enter** key is pressed before passing 1.5 second, at that time last selected letter will be entered in to field immediately.
- In **Site name** field, pressing key for first time displays first letter on key no digit.
- In **Serial no** field, pressing key for first time displays digit on key no letters.

ⓘ In Test No to be saved field keys are only in digit format.

Printing test result

Printing test result is possible in two ways:

- By pressing key **3** in **Time test result** page

OUT OF SYNC : 0.9 ms	
ACT>Save test	3>Prn

- By pressing key **3** in **Displaying saved test**

POST ANJIRAK	06:05
SN:12345678	CLOSE
DATE:860205	TIM:1145
1>View	2>Del 3>Prn

After pressing key **3**, this message is appeared: **Print page? (0/1/2/3)**

If key **1** is pressed, test results of main contacts (A, B, C) are printed:

TIME TEST RESULT

DATE:87/10/23		TIME:15:47	
TEST: C_T_O		SN:12345678	
CONTACTS OPERATION TIME (ms)			
	FC	LC	D
A:	3.8	97.5	93.7

B: 4.5 94 89.5

C: 4.1 93.9 89.8

OutOfSync: 0.7

Model:BT12

TAPCO

If key **2** is pressed, test results of 8 first auxiliary contacts (A to C5) are printed:

TIME TEST RESULT

DATE:87/10/23 TIME:15:47

TEST: C_T_O SN:12345678

CONTACTS OPERATION TIME (ms)

	FC	LC	D
A:	3.8	97.5	93.7
B:	4.5	94	89.5
C:	4.1	93.9	89.8

OutOfSync: 0.7

C1: 0.0 0.0 0.0

C2: 0.0 0.0 0.0

C3: 0.0 0.0 0.0

C4: 0.0 0.0 0.0

C5: 0.0 0.0 0.0

Model:BT12

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key 3 is pressed, test results of all 16 contacts are printed:

TIME TEST RESULT

DATE:87/10/23 TIME:15:47

TEST: C_T_O SN:12345678

CONTACTS OPERATION TIME (ms)

	FC	LC	D
A:	3.8	97.5	93.7
B:	4.5	94	89.5
C:	4.1	93.9	89.8

OutOfSync: 0.7

C1:	0.0	0.0	0.0
C2:	0.0	0.0	0.0
C3:	0.0	0.0	0.0
C4:	0.0	0.0	0.0
C5:	0.0	0.0	0.0
C6:	0.0	0.0	0.0
C7:	0.0	0.0	0.0
C8:	0.0	0.0	0.0
C9:	0.0	0.0	0.0
C10:	0.0	0.0	0.0
C11:	0.0	0.0	0.0
C12:	0.0	0.0	0.0
C13:	0.0	0.0	0.0

Model:BT12

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If key **0** is pressed, none of above pages is printed and this message is appeared: **Print curve?(1:Yes)**

If **ESC** key is pressed no print is done.

If **1** key is pressed something similar to this diagram is printed:

TIME TEST RESULT

SITE NAME: B

DATE: 90/10/28 TIME: 14:37

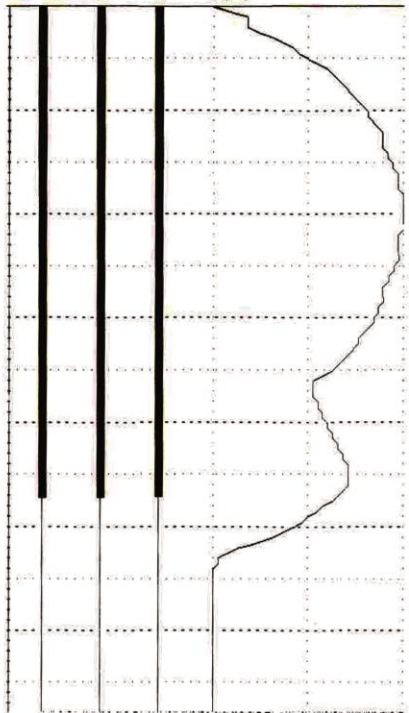
TEST: OPEN SN: 85641

SAMPLING TIME: 200ms

CONTACTS & COIL CURRENT CURVE

Legend: 1ms 5ms 10ms
 | | |
 | | |

T(ms) COIL CURRENT (A)
0 A B C 0(A) 1.52



ⓘ If print command is run in **Time test result** page (Before saving in memory) **Site name** and **Serial no** will be printed as ?

Contact operation time

To see times that contact status has been changed, select 8th option in **Breaker test** page. By pressing key **8** this page is appeared:

Which Contacts?
 1>A-C5
 2>C6-C13

According to pressed key in this page (1 or 2) one of these pages are shown:

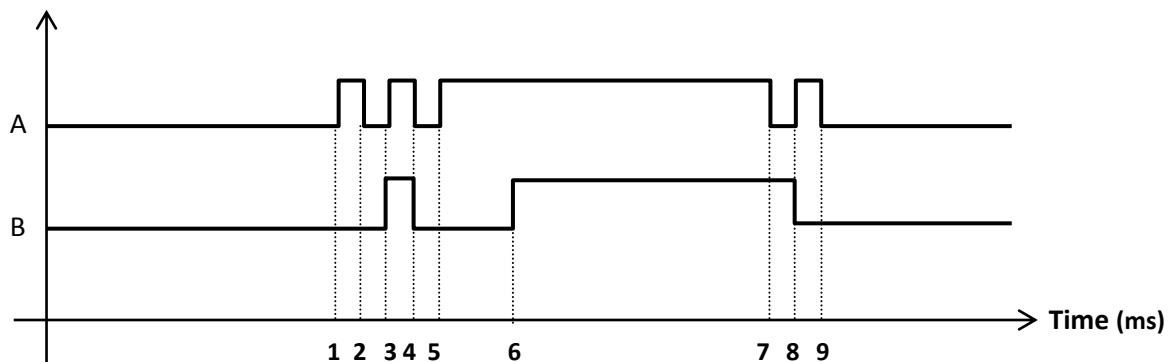
A : 0 C2: 0
 B : 0 C3: 0
 C : 0 C4: 0
 C1: 0 C5: 0 T: 0.0

Key 1 (A-C5)

C6: 0 C10: 0
 C7: 0 C11: 0
 C8: 0 C12: 0
 C9: 0 C13: 0 T: 0.0

Key 2 (C6-C13)

In these pages, contacts status is shown when at least one of their status changed. By pressing ↑, time goes forward and if at least one of contacts changed, new contacts status are shown. Related time of this new status is shown at bottom of LCD (in front of T:). In this example, points 1,2, ... are the times which are shown by pressing ↑:



For each point, status of contacts A and B are as follow:

	1	2	3	4	5	6	7	8	9
A	1	0	1	0	1	1	0	1	0
B	0	0	1	0	0	1	1	0	0

ⓘ 1 means contact is close, 0 means contact is open.

Contact status page

By pressing key **7** in **Breaker test** page, this page is appeared:

A : 1	C2: 0	C6: 0	C10: 0
B : 1	C3: 0	C7: 0	C11: 0
C : 1	C4: 0	C8: 0	C12: 0
C1: 0	C5: 0	C9: 0	C13: 0

In this page, open or close status of each contact is shown.

1 means contact is close, **0** means contact is open.

Delayed test page

Delayed test means BT12 starts sampling when at least one of main contacts acts. Note that in normal test, when **ACT** key is pressed, sampling is started regardless to status of contacts.

For entering to this page, press key **2** in main page. **Delayed test** page is appeared as:

DELAYED MANEUVER	
1>CLOSE	
2>OPEN	
	OP

Some usage of this test type is:

- Doing open and close action by hand not by coils.
- Breaker doesn't have open or close coil.
- Opening or closing breaker is done by circuits that have more delay at starting of maneuver so that in normal test, BT12 cannot sample contacts and sampling time will be finished before BT12 gathers samples.

In this page, follow functions are possible:

- Pressing key **1** means start **Close** test
- Pressing key **2** means start **Open** test
- Pressing key **ESC** means exit page

By pressing key **1** or **2** this page will be appeared:

WAIT FOR DELAYED MANEUVER ...
--

Now, BT12 is waiting for one of main contacts (A, B or C) to act. In this status, to exit page one of main contacts must be acted or one of keys must be pressed for 1 second. Maximum time that BT12 waits in this page is 655 seconds (about 11 minutes). After passing this time, BT12 exits from this page.

After operating one of main contacts this page is shown:

```

OUT OF SYNC : 0.9 ms
START DELAY: 2.84 s

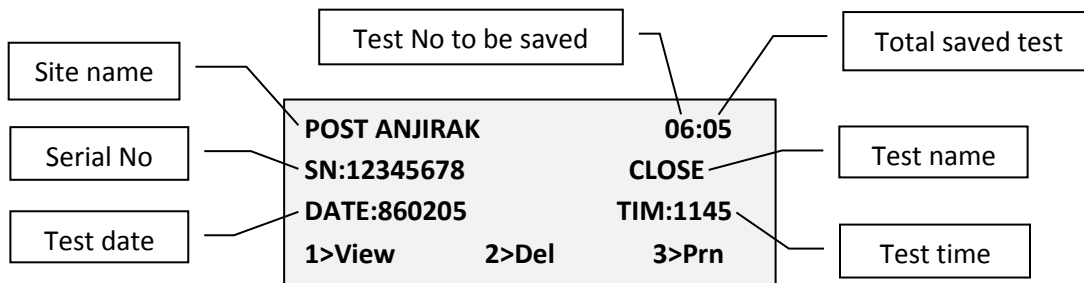
ACT>Save test      3>Prn
  
```

Primary delay of first operated contact is appeared as **START DELAY**.

Other functions such as observing time test results, printing result and ... are like normal test (**Breaker test** page). In this page, **START DELAY** is also printed.

View saved tests page

By pressing key **3** in main page, saved tests are observable again:



By using \uparrow and \downarrow you can move on saved tests in BT12 memory and see their information.

At the bottom of page, valid keys are listed:

- **1>View**: by pressing key **1**, **Time test result** page is appeared for selected test (displayed test).
- **2>Del**: by pressing key **2**, you can delete selected test. When message **Delete? <ENTER>** appeared, you must press **Enter** key to delete.
- **3>Prn**: by pressing key **3**, test result will be printed.

*Refer to **Printing test result** section.*

*by pressing key **4**, all saved tests are deleted. Message **Delete? <ENTER>** is appeared twice and to delete all tests, you must press **Enter** key each time.*

Setup page

By pressing key **4** in main page, **setup page** is appeared:

1>TEST PARAMETERS
2>RTC
3>PASSWORD

Test Parameters

To do different tests, some parameters like sampling time, coils excite time and ... are able to set. **Test parameters** page is included two pages:

- **Page 1:**

Sample time1 : 200 ms
Sample time2 : 100 ms
Interdelay OC : 300 ms
Interdelay CO : 300 ms

Parameters in this page are:

- **Sample time1:** It determines sampling time for single maneuvers (Close, Open). This parameter is valid **0 to 255ms**.
- **Sample time2:** It determines sampling time for multistage maneuvers (such as Close-Delay-Open, Open-Delay-Close and ...). This parameter is valid **0 to 200ms**.
- **Interdelay OC:** It determines delay between Open-Delay-Close. This parameter is valid **0 to 999ms**.
- **Interdelay CO:** It determines delay between Close-Delay-Open. This parameter is valid **0 to 999ms**.

- **Page 2:**

Excite time : 75ms

Parameter in this page is:

- **Excite time:** It determines coils excite time. This parameter is valid **0 to 255ms**.

① Use ↓ and ↑ to move between different rows (items). If you pass last row of page1, you will enter to page 2.

① After changing each item, press **Enter** key to save new value.

① To exit from page, press **ESC**.

① Values in front of items in this manual are default values.

Internal RTC

To set internal date and time of BT12, press key **2** in **Setup** page. This page will be appeared:

Enter Password

Cur. Password:

Enter password. If password is correct, next page is appeared as follow:

① Default of password is **1**.

SET RTC

MODE: (0>SOL 1>CHRS)

DATE: 870117 (YYMMDD)

TIME: 154806 (HHMMSS)

Different items are:

- **MODE:** if **0** entered, date is assumed **Solar**. If **1** entered, date is assumed **Christian**.
- **DATE:** it must entered with this format:
YYMMDD that YY is stand as Year, MM as Month and DD as day
- **TIME:** it must entered with this format:
HHMMSS that HH is stand as Hour, MM as Minute and SS as second

Password

To set password, press key **3** in **Setup** page. This page is appeared:

Enter Password

Cur. Password:

Enter current password. If it is correct, next page will be appeared:

Enter Password
New Password:

By entering new password (maximum 5 digits for example 12345), below page is appeared:

Password changed
12345
Please remember it!

①Default of password is 1.

②Put password in a secret place so you can refer to it if needed.

③If you forgot password, contact TAPCO.

Chapter4- Connectors and Cables

Connectors

Sensors

One connector is predicted to attach to linear sensor and another connector to encoder (rotary sensor) in top panel. Pins function is as follow:

Connector pins for Linear sensor

Pin no	Function
1	Voltage +
2	Output
3	Voltage -

Connector pins for Encoder

Pin no	Function
4	Signal A
5	Ground
6	Signal B
7	Voltage +5

Serial port

Its type is DB9 (D-Connector type) female

Pin no	Function
2	TxD (Send To PC)
3	RxD (Receive From PC)
5	Ground

Loop back

Loop back connector used for serial port test is as follow:

Its type is DB9 (D-Connector type) female

Pin 2 is connected to pin 3

ⓄIt means pin 2 and 3 in DB9 must be connected to each other.

*ⓄTo test serial port of computer or serial port cable, refer to **Software** manual.*

Input power

Input power is 220V/ 50HZ that is connected to BT12 via this connector.

Cables

Input power (220V/ AC)

Use particular and safe cable.

Coil and motor powers

Choose cable for coils power at least 2*1 and cable for motor at least 2*1.5

Serial connection

Type: 3 wired, one side to DB9 male and the other side to DB9 female

Construction procedure: Pins 2, 3 and 5 of connectors must be connected to each other.

Linear sensor and encoder

Regarding to related connectors must be made and used.

Contacts

For each contacts use 2*1 cable.

Chapter5- Linear sensors calibration

In using different sensors like temperature, light, movement and ... in digital circuits, calibration of sensors circuits is very important. In the other words, measures appeared in sensor's output should be the same as to what digital circuits identifies and interprets.

Calibration of linear sensors has two stages. Description of required operation for calibrating a sensor will come in the following. For other sensors, the same operation should be done.

Each linear sensor should be calibrated by its own circuit. Therefore, enumerate sensors and if you calibrate a sensor as no.1, you have to use it as sensor no.1 unless it is recalibrated.

First stage: Voltages setting

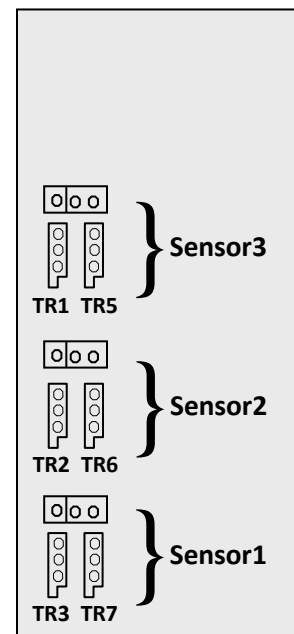
If you look at the main board from above, you can see 6 multi turns at the bottom left corner. According to the shape, every two of them are related to one of sensors. Each sensor need two voltages + and -. Multi turns TR1, TR2 and TR3 are related to voltage – and multi turns TR5, TR6 and TR7 are related to voltage +. Each sensor has a 3 pin connector for connecting it to main board. Pins function is as:

Pin no.	Function
1	Negative Voltage (V-)
2	Output
3	Positive Voltage (V+)

Order of pin's number is from left to right 1, 2 and 3.

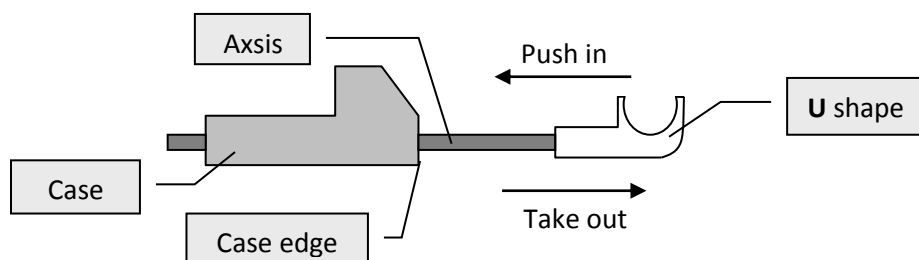
Voltages are measured to analog ground (pin 8 in IC ADC0804).

After connecting sensor to its connector, voltages + and – must be +10.3V and -3.5V. To set these voltages, first change multi turn of V+ of desired sensor so that it becomes +10.3V. Then change multi turn of V- of this sensor so that it becomes -3.5V. Changing each multi turn effects on voltage of other multi turn. So, do these changes periodic until both voltages reach near our measure as possible.



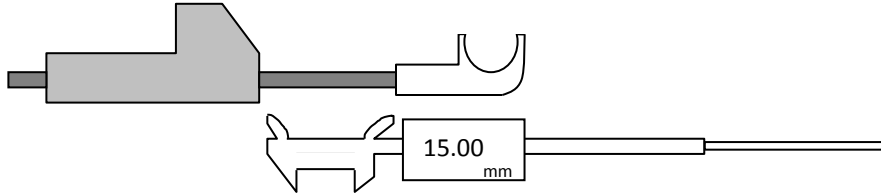
While working, be careful to prevent problem in board such as short circuit because of slipping screw from multi turn, it is recommended to use plastic screw instead, for example.

Before describing next stage, note that to following terms:



Second stage: Length calibration

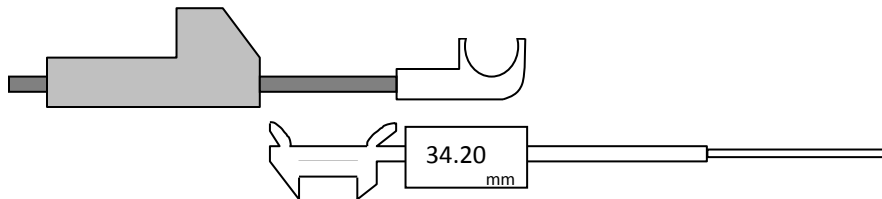
After completing first stage, while sensor is connected to board, place its axis in **zero point** status. For vacuum breakers VD4 this status is almost as below:



① Fix sensor's case on the surface.

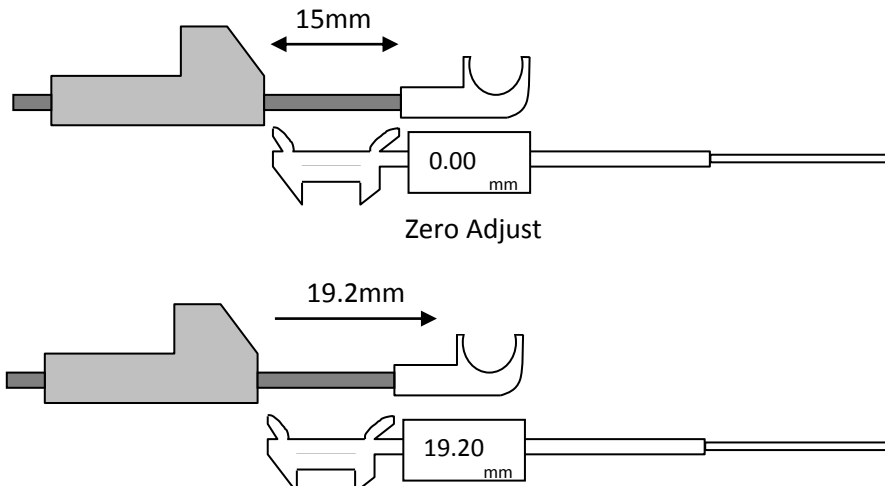
In this status (**zero point** of sensor), voltage of pin 6 in ADC0804 corresponding to the sensor which you calibrate it (it is on the right of sensor's multi turn) comparing to pin 8 should be zero. If it wasn't, change multi turn related to V- until this voltage becomes zero.

Now, take out axis as maximum sensor length (entered in **Constant settings** form) probably 19.2mm. In this status, voltage of pin 6 should be 5.11V comparing to pin 8. If it wasn't, change multi turn related to V+ until this voltage is set.



① Since changing one of multi turns, changes voltage of another, repeat above routine a few times until both voltages are set on desired measure as possible.

① To make it easier, you can make zero of caliper equal to **zero point** of sensor until above routine is done easier. In this case two mentioned status is as below:

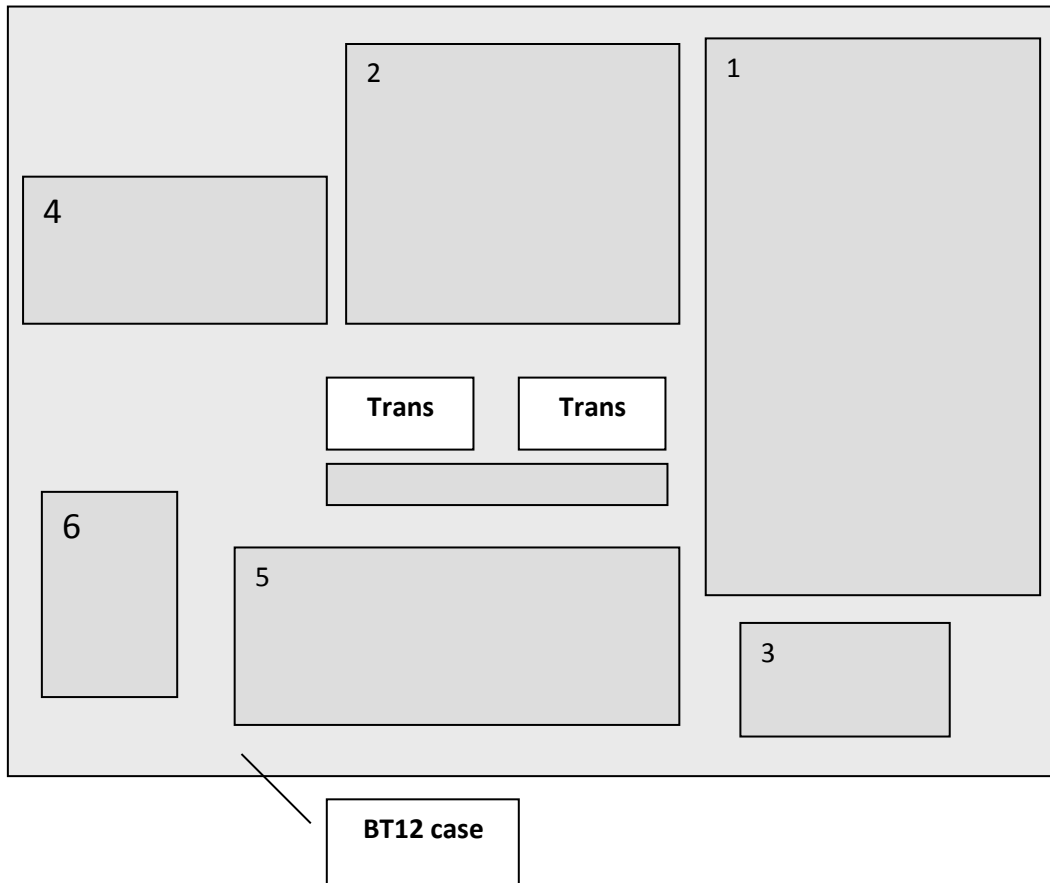


①If after finishing calibration, there is a difference between what computer shows to what caliper shows, you can use **linear sensor calibration** method in **software** manual.

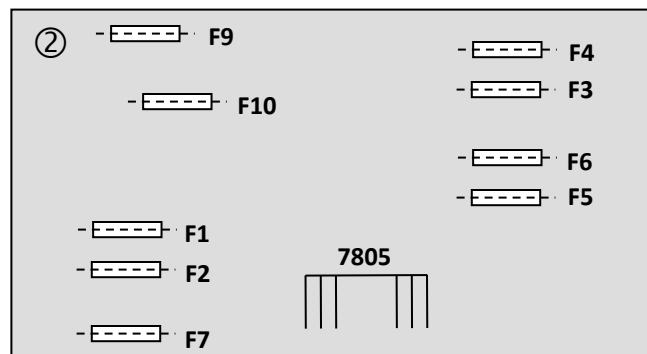
②Pay attention that this calibration is needed when difference between the measure computer shows and what sensor really changes is more than 1mm. Therefore, before calibration, test it in **Sensors and contactors** form. Test is like this: firstly, **zero point** must be proper. For vacuum breakers, when **U** shape is taken out 15mm, you must see **Zero** in form. Secondly, when **U** shape is taken out 34.2mm, no any changes must appear in form.

Chapter6- BT12 internal boards

There are 6 printed circuit board (PCB) in BT12 which they are ordered in this way:

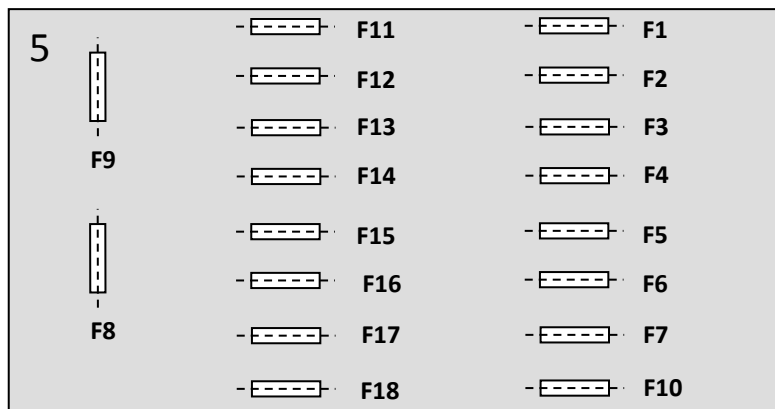


1. It is main board of BT12 which is included of micro controller, voltage and current measuring, sampling circuits (encoder and linear sensor).
2. It is supply board. In following diagram and table, status and task of each fuse on this board is put:



Supply +15V	500 mA	F1
Supply -5V (or -9V)	500 mA	F2
Supply +15V (Coil measuring section)	100 mA	F3
Supply -5V (Coil measuring section)	100 mA	F4
Supply +5V (Motor measuring section)	100 mA	F5
Supply -5V (Motor measuring section)	100 mA	F6
Supply +5V (main board)	1 A	F7
Coil voltage sampling section	50 mA	F9
Motor voltage sampling section	50 mA	F10

3. Serial board
4. It is to connect voltage of close and open coils.
5. Contacts board. In following diagram and table, status and task of each fuse on this board is put:



Position	Amper	Fuse No.	Position	Amper	Fuse No.
Contact C6	100 mA	F11	Contact A	100 mA	F1
Contact C7	100 mA	F12	Contact B	100 mA	F2
Contact C8	100 mA	F13	Contact C	100 mA	F3
Contact C9	100 mA	F14	Contact C1	100 mA	F4
Contact C10	100 mA	F15	Contact C2	100 mA	F5
Contact C11	100 mA	F16	Contact C3	100 mA	F6
Contact C12	100 mA	F17	Contact C4	100 mA	F7
Contact C13	100 mA	F18	Contact C5	100 mA	F10
			Supply +12V (related to voltage which is connected to contacts)	250 mA	F8
			Supply +12V (related to output of trans which prepares +12V)	500 mA	F9
