

Tense Electrical Electronics Industry

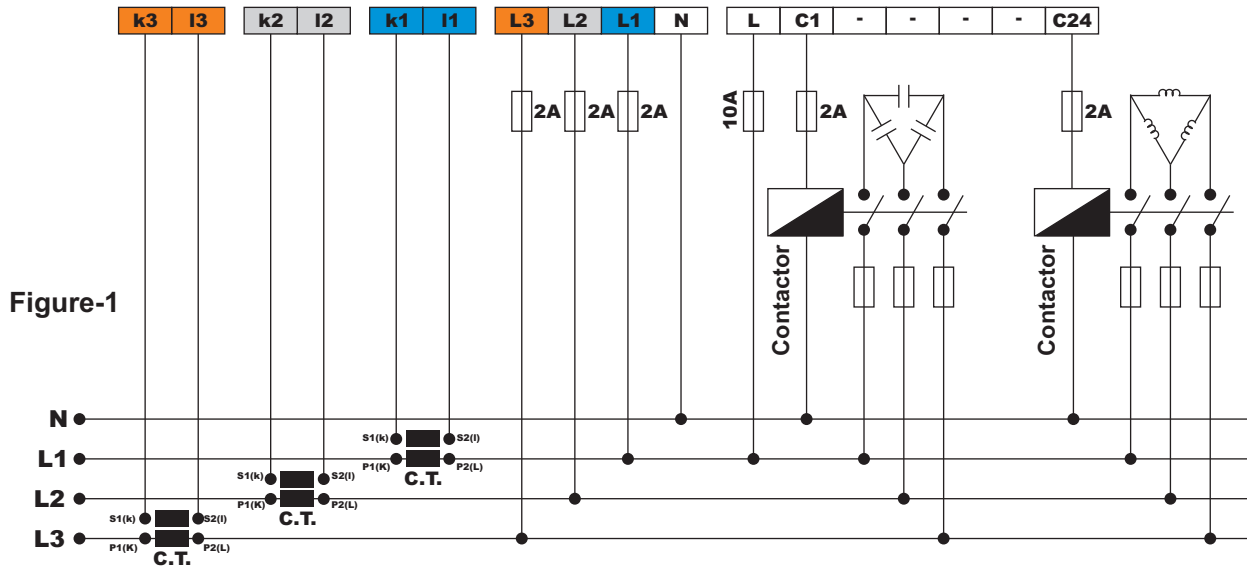
THREE-PHASE REACTIVE POWER CONTROL RELAYS MANUAL



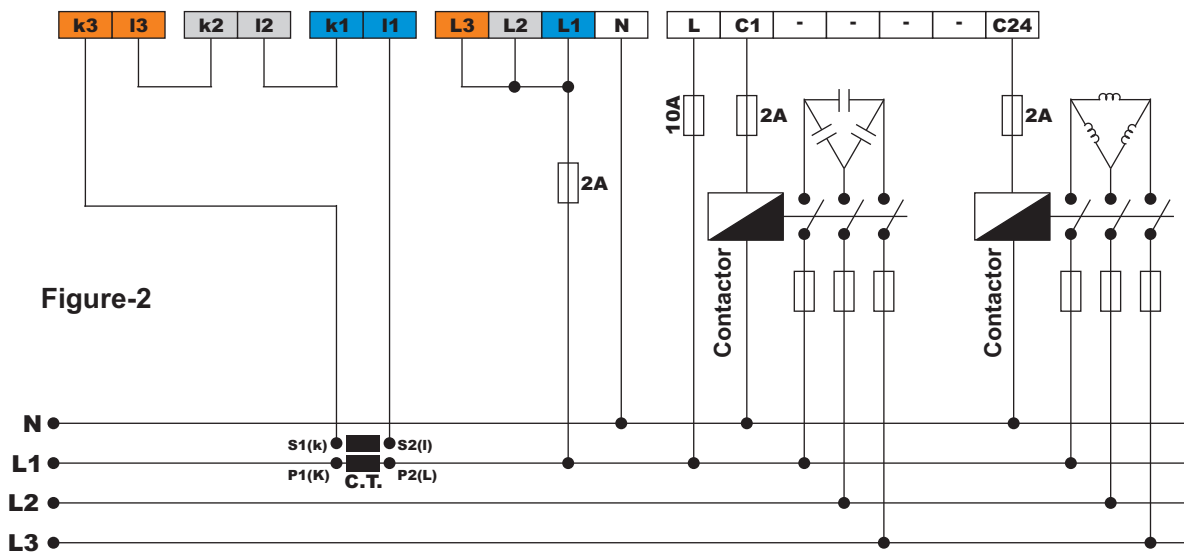
**EASY TO
USE**

- ✦ Compensating the inductive and capacitive systems.
- ✦ RS485 Communication (RGT-XXH)
- ✦ Thyristor Triggered (RGT-XXTX)
- ✦ 2x16 LCD, 3x4 digit led display, with data and warning led indicator
- ✦ 3 phase, 3-current transformer
- ✦ Three-phase, two-phase and single phase capacitor or shunt reactor can be connected
- ✦ It shows the Active power, Reactive power, Cos ϕ , THD, Total active and reactive values of each phase on the display.
- ✦ It shows the voltage, current and Cos ϕ values of each phase on the Led Display.
- ✦ Power flow Chart (It records the reactive powers withdrawn)
- ✦ Password protection.
- ✦ Setting the stage value manually (capacitor and shunt reactor).

1 - Reactive Power Control Relay Three-Phase Connection Diagram



2 - Reactive Power Control Relay Single-Phase Connection Diagram

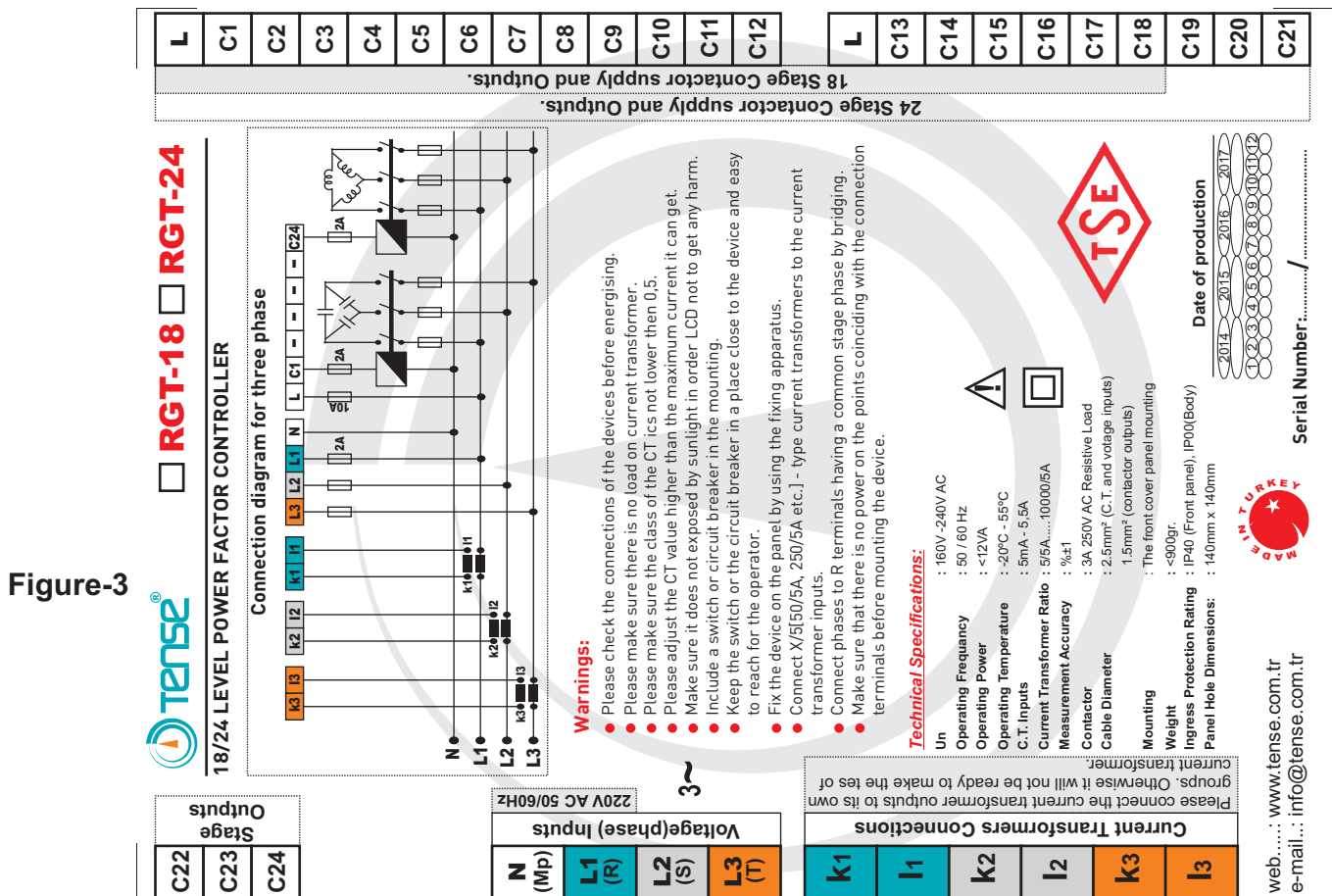


3 - Warnings

- Use the device in accordance with the instructions given by us.
- Make sure that the LCD Display is kept away from the sunlight in order not to be damaged.
- Make sure that the operating temperature of the panel on which the device will be mounted should be between $-20\text{ }^{\circ}\text{C}$ - $55\text{ }^{\circ}\text{C}$.
- Leave minimum 5 cm space behind the device after it is mounted.
- Fix the device with the apparatus provided with the device on the front cover of the panel so as not to be loose.
- Make sure that the panel on which the device operates is not in humid environment.
- Balance the internal and external temperatures for metal panels. Otherwise, water droplets form on the ceiling of the panel due to the temperature difference in humid environments and it is dangerous for the open connection bars.
- Include a switch or circuit breaker in the mounting.
- Keep the switch or the circuit breaker in a place close to the device and easy to reach for the operator.
- Fix the device on the panel by using the fixing apparatus.
- Connect X/5[50/5A, 250/5A etc.] - type current transformers to the current transformer inputs.
- Connect phases to R terminals having a common stage phase by bridging.

- Mark the switch and circuit breaker as a disconnection unit for the device.
- Select the values of automat fuse used in the stages in accordance with the capacitor or the reactor powers. Use separate automat fuse for each feed coil of the stage contactors.
- Stage contactors should resist to minimum two times of the current withdrawn by the condenser or the reactor.
- Use compensation contactors and discharge coil for the stages.
- Make sure that the connection types (Figure-1, Figure-2) are suitable for the systems to be used as three-phase or single phase.
- Single-phase connections on a three-phase system are only suitable with balanced power draw. Otherwise, the desired rates cannot be obtained.
- Make sure that the energies to the stages are connected after the current transformer.
- Make sure that connection cables have no power during the mounting.
- Screened and twisted cable should be used for the input and output lines having no connection with the network. These cables should not be passed close to the lines and devices having high power.
- Mounting and electrical connections should be carried out by the technical personnel in accordance with the instructions in the manual.
- Make sure that there is no power on the points coinciding with the connection terminals before mounting the device.
- Feed cables should be in accordance with the requirements in IEC 60227 or IEC 60245.

4 - RGT-18 / RGT-24 Connection Label



5 - Points to Take into Consideration in the Selection and Connection of Current Transformer

- Make sure that the current transformer value is higher than the maximum current drawn from the system.
- It is recommended to use a current transformer in class (can be specified as class, cl, kl) 0,5.
- Use the current transformers as X5 unless the special current transformers are delivered with the device.
- Make sure that there is no load before the current transformers, otherwise there comes up differences between the rates of the reactive and the counter.
- Connect the current transformer end terminals (k-l, S1-S2) according to the connection type. (k-l terminals of the current transformer connected to L1 phase to k1-l1 terminals, k-l terminals of the current transformer connected to L2 phase to k2-l2 terminals and k-l terminals of the current transformer connected to L3 phase to k3-l3 terminals.)
- In order to prevent any mistake while connecting the output terminals of the current transformer, use cables in different colors for each phase or give a number for each cable.
- Keep the cables connected to the output terminals of the current transformer away from the high-voltage line.
- In order to prevent any shake on the current transformer, fix it on the bus-bar, cable or rail.

6 - Points to Take into Consideration in Compensation

- The compensation starts with the regulation of the load distribution balancedly in the electrical installation of the system.
- Do not designate the number of stages and the capacitor values in the places where there are instant load changes or most loads are distributed imbalancedly.
- You can refer to the illustrations in Power Flow Graph for a more effective compensation to the unbalanced loads in the system.
- Make sure that the new stages should be added easily for the changes likely to occur while preparing the compensation panel (adding load or extracting load).
- Make sure that there is no instant load change in the system as much as possible during the current transformer and stage measuring.
- The device stage measuring will be carried out automatically about every two weeks while the system is fixed. Besides these, control it every three months. Renew the damaged contactors or the condensers which have low values or are out of order.
- You are recommended to add new stages in the same value in terms of the contactor and condenser in frequently used stages.

7 - General

Reactive power control relays are designed for the purpose of reducing the reactive powers (inductive and capacitive) not used by the loads and drawn from the network. If inductive power is drawn from the network, it intervenes by drawing capacitor in the suitable value. If the capacitive power is drawn from the network, it intervenes by drawing shunt reactor in suitable value. It tries to reduce the inductive/active and capacitive/active rates of the system this way.

8 - Use of the buttons

Menu button: It is used to enter the menu, advance in the menu, verify the selection and save the changes done.

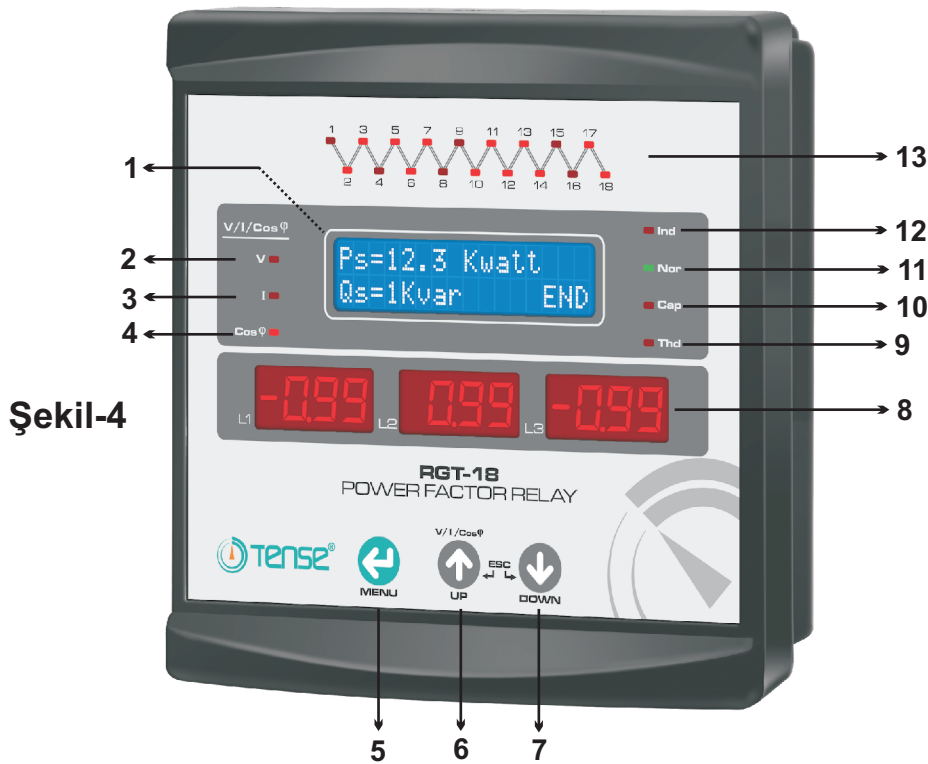
UP button: It is used to change the values in the menu, switch among the Volt, Current and $\text{Cos}\phi$ values in display group and navigate among the illustrations in the power flow graph.

DOWN button: It is used to change the values in the menu and navigate among the illustrations in the power flow graph. Whenever the display images are pressed, it ensures switching among the display images without waiting.

Up and Down (ESC) button: It is used as cancel or exit button when the up and down buttons are pressed in the same time. It cancels the test while Current and Stage tests are being taken. It enables to exit the menu.

9 - General Structure

- 1- 2x16 LCD Display: It shows the information about the use of the device and the system.
- 2- Voltage Led: It notifies that the voltage of each phase is shown on the display group.
- 3- Current Led: It notifies that the current of each phase is shown on the display group.
- 4- Cos ϕ Led: It notifies that the Cos ϕ of each phase is shown on the display group.
- 5- Menu button
- 6- Up button
- 7- Down button
- 8- 3x4 digit display: It shows V, C, Cos ϕ values of each phase.
- 9- Harmonic Led: The harmonic led lights up when it is over 30% in the system.
- 10- Capacitive Led: It shows that the capacitive set value is exceeded.
- 11- Normal Led: It shows that the capacitive and inductive rates are achieved.
- 12- Inductive Led: It shows that the inductive set value is exceeded.
- 13- Stage Leds: It shows the stages on (lights up if it is drawn)



10 - Normal Operation Display Images



Şekil-5

While the device is operating normally, the lcd display shows the active, reactive cos ϕ , 20-hour rates, THD, total active energy (+), total active energy (-), total inductive and total capacitive data of each phase on the display by turns.

The Figure-5 shows the active (P) power values of L1(R) phase on the first line. It shows reactive (Q) power value and whether the phase is IND (inductive) or CAP (capacitive) on the second line. It shows the other phases by turn as well.

```

Cos L1  L2  L3
 0.98 0.99-0.99

```

Figure-6

Figure-6 shows the Cos ϕ value of each phase. While the display indicator of the device is Cos ϕ , Lcd display keeps showing Figure-6. Push the down button to continue.

```

%IND      %CAP
 5.2      6.0

```

Figure-7

Figure-7 shows about 20-hour total inductive/active and capacitive/active rates. If you press the ESC button (up and down buttons in the same time), the rates are reset.

```

THD  L1  L2  L3
(%)  1   5   2

```

Figure-8

Figure-8 shows the Total Harmonic Distortion (THD) rate of each phase. When it is over 30%, the Har led on the right of the LCD display lights up.

```

Active Energy(+)
0000000000 W.h

```

Figure-9

Figure-9 shows the total active energy drawn from the network. You can reset the energy by entering the menu. Its unit is Watt/hour (W.h) and the code of the counter: 1.8.0

```

Active Energy(-)
0000000000 W.h

```

Figure-10

Figure-10 shows the total active energy given to the network. You can reset the energy by entering the menu. Its unit is Watt/hour (W.h)

```

Inductive Energy
0000000000 Var.h

```

Figure-11

Figure-11 shows the total inductive energy drawn from the network. You can reset the energy by entering the menu. Its unit is Var/hour (Var.h) and the code of the counter: 5.8.0

```

Capacitiv Energy
0000000000 Var.h

```

Figure-12

Figure-12 shows the total capacitive energy drawn from the network. You can reset the energy by entering the menu. Its unit is Var/hour (Var.h) and the code of the counter:8.8.0

The values of (1.8.0) and (8.8.0) will be multiplied with the multiplier value in order to compare the counter with the reactive in X5 type counters. E.g. in X5 counter with a current transformer of 700/5, the multiplier value=700/5=40.

The values in Figure-9 and 10 are specified in Watt and the values in Figure-11 and 12 are specified in Var. You can obtain the values of Kwatt and Kvar by dividing these values by 5 or putting point after three digits from the right side of the value.

11 - Menu Usage

Press the Menu button in order to enter the menu and advance in the menu. Press the ESC (up and down buttons in the same time) for 2 sec. in order to exit the menu. Use the up and down buttons in order to change any value in the menu and then press the menu button to save the changes.

```

STAGE VALUES
L1  L2  L3

```

Figure-13

When you press the menu button for the first time, the figure-13 stage values are displayed and the figure-14 is displayed automatically after 4 sec. It shows which stage it is in order in the first line and whether it is three-phase, double-phase or single phase. In the second line, it shows the power values of the phases L1(R), L2(S) and L3(T) from the left. You can see the other stage values by pressing the up or down button. If there is (-) before the power value, it shows that the power is shunt reactor (inductive). It cancels the stage if the stage has both capacitor and rector or none of them and it cannot use this stage. If there is 20% difference between the phases in the stage, it detects the stage as error. But it uses this stage when it is necessary. Figure-15 is displayed if you press the menu button.

```

KD 1 THREE  kVAR
0.55 0.54 0.53

```

Figure-14



```
STAGE TEST?  
YES >>NO
```

Figure-15

Figure-15 When any change is made in the stages, this menu is used. All or one of the stages can be measured by using this menu and you can enter the stage value manually. Switch the mark of (>>) to Yes by pressing the up or down button in order to test the stage and press the menu button. Press the menu button to advance in the menu.



```
C.T. TEST?  
YES >>NO
```

Figure-16

Figure-16 When any change is made in the current transformer or the connections, the current transformer test is done here. Switch the mark to Yes by pressing the up or down button in order to test and then press the menu button. Press the menu button to advance in the menu.



```
STAGE CONTROL  
YES >>NO
```

Figure-17

Figure-17 It ensures manual controlling of the stages and shows how many times the stage is used. Switch the mark to Yes by pressing the up or down button in order to control the stage and learn the number of stage use and then press the menu button. Press the menu button to advance in the menu.



```
LOAD FLOW GRAPH.  
16.SAMP DIFF% 15
```

Figure-18

Figure-18 It saves the reactive powers drawn by the system from the networks in examples with its time references in the power flow graph. Figure-19 is displayed 2 sec after the figure-18 is displayed. You can navigate among the examples by pressing the up or down button. Press the menu button to advance in the menu.



```
1.SAMP %4 16 m  
1.0 1.1 1.7
```

Figure-19

Figure-20 You can access the advanced settings from here. Switch the mark to Yes by pressing the up or down button in order to enter the settings and then press the menu button. You can change the current transformer value, inductive and capacitive set values, intervention time, capacitor discharge time and enter the expert menu. Press the menu button to advance in the menu.



```
ADVANCED MENU  
YES >>NO
```

Figure-20



```
EXPERT MENU  
YES >>NO
```

Figure-21

Figure-21 You can enter the expert settings from here. Switch the mark to Yes by pressing the up or down button in order to enter and then press the menu button. Energy values can be reset, power flow graph can be deleted, password value, stage transition time, capacitive and inductive delay time, off set stage, inductive

and capacitive tolerance, and response resolution values can be entered by using this menu and you can return to the factory default values. Press the menu button to advance in the menu.

12 - Advanced Settings Menu



```
CURRENT T. VALUE  
30/5 AMPER
```

Figure-22

When you get in the advanced settings menu, firstly the figure-22 is displayed. When you make changes in the current transformer values, press the up or down buttons and enter the value specified on the current transformer and then press the menu button. The device releases any withdrawn stage and starts the current

transformer test. Factory default setting=5/5, Settings area:5/5-10000/5. Press the menu button to advance in the menu.



```
INDUCTIVE SET  
%5
```

Figure-23

Figure-23 The desired inductive/active rate is set. You can change the set value by pressing the up or down button. Then press the menu button to save. Factory default setting=5%, Settings area:1%, -99% Press the menu button to advance in the menu.



```
CAPACITIVE SET  
%11
```

Figure-24

Figure-24 The desired capacitive/active rate is set. You can change the set value by pressing the up or down button. Then press the menu button to save. Factory default setting=11, Settings area:1%, -99% Press the menu button to advance in the menu.



RESPONSE TIME
2.00 SEC

Figure-25

Figure-25 It determines the time of response to the power variation in the system. You can change the response time by pressing the up or down buttons. Then press the menu button to save. Factory default setting=2sec, Settings area:0.4sec-20sec. Press the menu button to advance in the menu.



STAGE DISCHARGE
14.00 SEC

Figure-26

Figure-26 It determines the capacitor discharge (repeating the same stage) time. You can change the time by pressing the up or down button. Then press the menu button to save. Factory default setting=14sec, Settings area:0.4sec-20sec.

When you press the menu button, the expert settings menu will be displayed. If you press the menu button again before entering the expert settings menu, you return to the main menu.

13 - Expert Settings Menu



PASSWORD VALUE
OFF

Figure-27

When you enter the expert settings menu, the Figure-27 will be displayed for the first time. Password protection is activated to enter the menu. There is no password protection when the password value is "off". Enter the password you wish by pressing the up or down button and then press the menu button to save.

When you want to enter the menu again, the device asks you for the password. Enter here the password that you used before by pressing the up or down buttons and press the menu button. It will enter the menu if the password is correct. If it is wrong, it will return to the previous display. Press the menu button to advance in the menu.



RESET ENRG INDEX
YES >>NO

Figure-28

Figure-28 It resets the total active energy (+), active energy(-), inductive energy and capacitive energy values. Switch the mark to Yes in order to reset the energy values and then press the menu button. Press the menu button to advance in the menu.



RESET FLOW GRAPH
YES >>NO

Figure-29

Figure-29 It deletes the examples in the power flow graph. Switch the mark to Yes in order to delete the examples and press the menu button. Press the menu button to advance in the menu.



St Passing Time
30x10 msec

Figure-30

Figure-30 It adjusts the inter stage wait time while it draws the stages in groups. You can change this time by pressing the up or down button. Then press the menu button to save. Factory default setting=30X10(300)msec., Settings area:10msec, -2550msec. Press the menu button to advance in the menu.



CAP DELAY FACTOR
1

Figure-31

Figure-31 It adjusts the intervention time delay in capacitive loads. This time is obtained by multiplying the multiplier value with the intervention time. You can change the time by pressing up or down button. Then press the menu button to save. Factory default setting=1, Settings area:1-50. Press the menu button to advance in the menu.



IND DELAY FACTOR
1

Figure-32

Figure-32 It adjusts the intervention time delay in inductive loads. This time is obtained by multiplying the multiplier value with the intervention time. You can change the time by pressing up or down button. Then press the menu button to save. Factory default setting=1, Settings area:1-50. Press the menu button to advance in the menu.



OFF SET STAGE
OFF

Figure-33

Figure-33 It enables the load difference between the compensation panel and the counter to reduce. You can select the stage on which you will enter this difference by pressing the up or down buttons. Then press the menu button to save. Factory default setting=OFF, Settings area: OFF- Stage No. Press the menu button to advance in the menu.



IND SET TOLERANC
5

Figure-34

You can change the tolerance value by pressing the up or down buttons. Then press the menu button to save. Factory default setting=5, Settings area:1-20. Press the menu button to advance in the menu.



CAP SET TOLERANC
2

Figure-35

You can change the tolerance value by pressing the up or down buttons. Then press the menu button to save. Factory default setting=1, Settings area:1-20. Press the menu button to advance in the menu.



Respond Rsltion
30

Figure-36

Figure-36 It ensures the device to stay dead during compensation. You can change the deadness value by pressing the up or down button. Then press the menu button to save. Factory default setting=30, Settings area:1-60. Press the menu button to advance in the menu.



SET DEFAULTS?
YES >>NO

Figure-38

Figure-38 It saves the intervention and stage discharge and stage layout times, password, inductive set, capacitive set, inductive tolerance and capacitive tolerance, inductive delay, capacitive delay, offset stage, response resolution values to the factory default values.

Switch the mark to Yes in order return to the factory default values and then press the menu button. It returns to the main menu when the menu button is pressed again.

14 - Information Messages



OTO STG TST TIME

Figure-39

Figure-39 The device makes automatic stage test about every 2 weeks when the powers are fixed. It informs that the stage test is soon and the test will start.



CAPACITOR NEEDED

Figure-40

Figure-40 The device informs that the condenser values of the stage is insufficient considering the reactive power drawn by the system and the condenser values need to be increased.



YUK KAPASITIFTE

Figure-41

Figure-41 The device informs that there are capacitive powers in the system. The shunt reactor to respond to the capacitive loads is required to be added to the stage. Furthermore, control the contact adhesion.



CURRENT EXCEED

Figure-42

Figure-42 The device informs that the current flowing through the transformer outlets is over 5 ampere. The current transformer value should be increased otherwise current transformer and the device may be damaged.



INDUCTIVE EXCEED

Figure-43

Figure-43 The device informs that the inductive limit values is exceeded. It is required to call the technical service.



CAPACITIV EXCEED

Figure-44

Figure-44 The device informs that the capacitive limit values are exceeded. It is required to call the technical service.

15 - Start-up of the device



CURRENT T. VALUE
5/5 AMPER

Figure-45

Before the device is energized, you must read the warnings and the points to be taken into consideration. When the device energized for the first time, the figure-45 is displayed. Enter the current transformer value used in the system by pressing the up or down button and then press the menu button. The figure-46 is displayed. It gives warning to prevent any sudden load changed in the system for better test results. Then it starts the current transformer test by drawing the first three stages.



C.T. TEST CONTR1
STABLE LOAD NEED

Figure-46

```
L1 1 L2 1 L3-1
L1 1 L2 1 L3-1
```

Figure-47

The device writes the markings of 1 or -1 near each phase when it completes the current transformer test. It starts a second test to make certain the connection. When it concluded the test successfully, a message is displayed like the figure-47. The marking of "1" shows that the k and l terminals are

connected properly and the marking of "-1" shows that the connection of k and l terminals is wrong. However, the device corrects the improper connection of k and l terminals automatically.

```
STGE CURRENT LOW
L1 L2 L3
```

Figure-48

If the device does not reach the sufficient power in stage current, a message like the figure- 48 is displayed and it tries to reach the target power by increasing the number of the stage. If this warning is displayed although all stages draw it means that the capacitors in the stages have finished or at least one of the phases L1, L2 or L3 does not come to the stage. If the stages of three phases are shown low, the energy flowing to the stages may be connected before the current transformers or there may be loose contact between the current transformer k-l terminals. The phase or phases with low stage current are displayed.

If the figure-49 is displays during the current transformer test, the class levels (cl., class) of the current transformers may be high (1 or 3). The phase inlets of the device and the current transformer k-l terminals of that phase may not be in the same group. In this case, shut off the device and change the place of the phases displayed and repeat the test. If the connections are correct but it gives the same error again, there may be instant load variations. In this case, cancel the test by pressing the ESC (up and down) button. Then normal operating display (figure-5) will be shown. See the active (P) value of each phase from here. If the value is 1 Watt although the load is drawn, change the k-l terminals of that phase. You will complete the current transformer connection this way.

```
INVERSE L1 L2 L3
or load not stbl
```

Figure-49

```
STAGE TEST
STABLE LOAD NEED
```

Figure-50

After the current transformer test is completed, the device starts the stage test automatically and the figure-50 is displayed. The first line shows the stage drawn.

```
2.STAGE TEST
1.THREE
```

Figure-51

The second line shows the stage (SINGLEPHASE; TWOPHASE and THREEPHASE) measured before. If there are sudden load changes in the system, it draws the same stage again (10 times at maximum) for more reliable measurement. After the stage test finishes, the figure-56 will be displayed. After the stage measurement is completed, make sure that the device measured the stage values just as you have connected by entering the menu.

just as you have connected by entering the menu. After the stage measurement is completed, make sure that the device measured the stage values just as you have connected by entering the menu. After the current transformer and stage tests are completed, the device turns to the normal operating mode and starts to intervene depending on the requirement of the system.

16 - Doing Stage Test

```
STAGE TEST?
YES >>NO
```

Figure-15

Press the menu button and enter the menu in order to do the stage test. Advance by pressing the menu button and select "Do the Stage Test". Switch the mark to (>>) Yes and press the menu button. Figure-52 will be displayed again. Select the option of Single by using the up or down button and press the menu button. Figure-53 will be displayed. Select the stage that you want to measure by pressing the up or down button and press the menu button. The device releases the stages drawn, warning message is displayed as in figure-54 and starts to measure the stage that you select. If the figure-55 is displayed after it releases the stage, it means that there has been sudden load change in the system. Re-test is possible for 10 times at maximum. After the stage test is completed, the figure-56 is displayed. The device turns to normal operating mode. Then enter the menu and control the values of the stage that you measure by the stage values.

```
TEST TYPE?
>>ALL SINGLE
```

Figure-52

```
SELECT STAGE
1. STAGE
```

Figure-53

```
STAGE TEST
STABLE LOAD NEED
```

Figure-54

STAGE PREPARING

Figure-55

STAGE TEST DONE

Figure-56

1 MANUEL ENTRY
> 0.00 0.00 0.00

Figure-57

ENTRY OK?
YES >>NO

Figure-58

17 - Entering Stage Value Manually

While performing the stage test, hold the up button when it draws the stage until the figure-57 is displayed. It shows in the first line the stage where you will enter the value. It shows in the second line the phases L1(R), L2(S) and L3(T) starting from the left. In order to enter values, press the up (increase) or down (reduce) button in the phase with the mark (>). Press the menu button in order to pass to the other phase. Enter value to the phase you connect only in order to enter single phase or two-phase stage value and make the value of the other phases "0". If you press the menu button in L3 phase, the figure-58 is displayed. Select Yes by using the up or down button in order to save the value you enter and press the menu button. Press the menu button to set the value again when No option is selected. If you press the menu button when Yes is selected, the figure-56 is displayed and you finish the stage measurement.

18 - Stage Control and Learning the Number of Use

STAGE CONTROL
YES >>NO

Figure-17

ST 1 STATUS : Off
USAGE : 0

Figure-59

1. STAGE ON
YES >>NO

Figure-60

1. STAGE OFF
YES >>NO

Figure-61

Enter the menu to control the stages or learn the number of use and advance by pressing the menu button until the figure-17 is displayed. Press the up or down button here to select Yes and press the menu button. The figure-59 will be displayed. It shows in the first line the stage that you are on and if the stage is drawn or not. "Off" means the stage is released and "On" means the stage is drawn. It shows the number of stage use in the second line. Go to the stage you want by using the up or down buttons and press the menu button. If the stage is "Off", the figure-60 will be displayed and if the stage is "On", the figure-61 will be displayed. Select Yes when it shows the figure-60 by using up or down buttons and press the menu button and see it draws the stage. When the figure-61 is shown, select Yes by using up or down button, press the menu button and see it releases the stage. Press the up and down button together to exit.

The lifetime of the contactors and condensers shortens due to the intense use of some stages in the systems. And also, capacitors are required to wait for a certain time to discharge. If the system needs a capacitor not discharged within this time, it will affect the compensation negatively as the device will wait for this period. It is required to add stages equivalent to those used intensely for such cases. The device will draw the stages which are accepted by the device as equivalent in the same number which extends the lifetime of the contactors and capacitors and helps the compensation by intervening the system in a shorter time when necessary. It is required that the difference between the stage values should be less than 10% so that the device can accept two or more stages as equivalent.

19 - Doing Current Transformer Test

CURRENT T. TEST?
YES >>NO

Figure-16

CURRENT T. VALUE
30/5 AMPER

Figure-22

Enter the menu to do current transformer test and advance by pressing the menu button until the figure-16 is displayed. Press the up or down button here to select Yes and press the menu button. It releases the stages drawn, if any, and the figure-46 warning display is shown. Then it starts the test by drawing the first three stages, if the stage power is sufficient (1,5Kvar three-phase capacitor is sufficient for 30/5 current transformers) and if it could measure the connection terminals, the first line of the figure-47 is displayed. In order to guaranty the test, it draws the same stages again. If it could measure the connection terminals

again, the figure-47 is displayed together with its first and second lines. If the stage power is insufficient, the device tries to reach the required power level by increasing the number of stages.

C.T. TEST CONTRI
STABLE LOAD NEED

Şekil-46

L1 1 L2 1 L3-1
L1 1 L2 1 L3-1

Şekil-47

If it could measure the connection terminals again, the figure-47 is displayed together with its first and second lines. If the stage power is insufficient, the device tries to reach the required power level by increasing the number of stages.

Enter the menu to test due to the change in current transformer value and advance by pressing the menu button until the figure-17 is displayed. Press the up or down button here to select Yes and press the menu button. It releases the stages drawn, if any, and the figure-46 warning display is shown. Then it starts the test by drawing the first three stages, if the stage power is sufficient (1,5Kvar three-phase condenser is sufficient for 30/5 current transformers) and if it could measure the connection terminals, the first line of the figure-47 is displayed. In order to guaranty the test, it draws the same stages again.

20 -How to Prepare Power Flow Graph ?

Table-1	R	S	T	Time
1.Sample	1.00	1.00	1.50	230min.
2.Sample	0.50	0.50	1.00	153min.
3.Sample	0.70	1.20	0.70	150min.
4.Sample	1.60	1.50	1.60	125min.
5.Sample	0.50	1.00	0.50	110min.
6.Sample	0.35	0.35	0.35	98min.
7.Sample	0.19	0.19	0.20	75min.
8.Sample	0.85	0.85	0.86	74min.
9.Sample	1.70	2.20	1.70	62min.
10.Sample	2.00	2.10	2.00	53min.

It is an application especially for the unbalanced systems. It receives samples of different reactive powers from the system and saves them. If the difference between the examples is less than 15%, they are perceived by the device as equivalent and sum up their times. If the difference is over 15%, then the device records them as different samples and increases the rate which is 15% by one unit and tries to extend the sampling time.

The samples give information about the number of stages based on power distribution, capacitor or reactor values and stage connection ways (three-phase, two-phase and single phase). In the line with these data, it is possible to adjust the structure of stage, and apply efficient compensation on unbalanced loads.

Table-2

Three Phase capacitors		
1.Sample	3Kvar three phase	230min.
2.Sample	1,5Kvar three phase	153min.
3.Sample	2Kvar three phase	150min.
4.Sample	4,5Kvar three phase	125min.
5.Sample	1,5Kvar three phase	110min.
6.Sample	1Kvar three phase	98min.
7.Sample	0,5Kvar three phase	75min.
8.Sample	2,5Kvar three phase	74min.
9.Sample	5Kvar three phase	62min.
10.Sample	6Kvar three phase	53min.

Reach the power flow graph by pressing the menu button of the device. Write in which order the sample is, separate value and time of each phase in the first line, starting from the first sample on the display in Figure-19. The capacitive values have the marking of (-) in the samples. You can write as in Table-1.

The device should receive power flow graph for minimum one day. The values specified in Table-1 include 10 samples and a time period over 18 hours. Let's determine the number and values of the staged by taking these values into consideration.

Make sure that the times for samples we will take into consideration for compensation having fewer stages are in minutes.

Consider the samples in sec at high values.

Table-3

Mono Phase Capacitors				
	R	S	T	Time
1.Sample			0.50	230min.
2.Sample			0.50	153min.
3.Sample	0.50		0.50	150min.
4.Sample	low value			125min.
5.Sample		0.50		110min.
6.Sample	low value			98min.
7.Sample	low value			75min.
8.Sample	low value			74min.
9.Sample		0.50		62min.
10.Sample	low value			53min.

Firstly write the three-phase capacitor values to be used in the sample as in Table-2. We are going to determine the three-phase capacitors using this table.

For between the lowest 0,5kvar and highest 6kvar to interfere the loads, average values of capacitors must be used.

Total 5 stage 7Kvar three-phase capacitors including 0.5Kvar, 1Kvar, 2 units of 1.5Kvar and 2.5Kvar can be used.

While determining the mono-phase capacitors, write the mono-phase capacitor values of each phase after using the three-phase ones as in the table-3.

0.5Kvar mono-phase capacitor is required for T(L3) phase for the samples 1, 2, and 3 in the table-3.

0.5Kvar mono-phase capacitor is required for R(L1) phase for the samples 3 in the table-3.

0.5Kvar mono-phase capacitor is required for S(L2) phase for the samples 5 and 9 in the table-3. As the mono-phase values in the examples 4, 6, 7, 8 and 10 are low, you don't need to take into consideration.

21 - Stage Layout Time



St. Passing Time
30x10 msec

Figure-30

Time of the currents should be lower than the stage layout time when the capacitors are activated. Otherwise, contactors and condensers may be damaged. If there are capacitors having high values, the stage layout time should be high. If there are capacitors having low values in the stage, 300msec (30X10) is sufficient. For example, it should be Value=100X10msec in order to bring the time to 1 sec.

22 - Off Set Stage



OFF SET STAGE
OFF

Figure-33

It ensures that we enter the load values between the compensation panel and counter (the values read by the reactive relay but the Counter). An empty stage is required to be designated in order to enter the value of this stage. The order in which the stage is should be entered.

Then you should enter the value manually for this stage while performing stage test. It is required to find the difference between the total inductive and capacitive values of the counter and reactive relay within a certain time period (e.g. 15 min) in order to determine the value to be entered to this stage. If the inductive has the difference, then the value to be entered to the stage must have negative (-) sign. The inductive difference generally results from absence of fixed capacitor or its low value as compared to transformer. The capacitive difference generally results from its long cable distance or fixed capacitor's high value s as compared to the transformer.

Example: Suppose that total capacitive (8.8.0) value of the counter is 1Kvar higher than the total capacitive energy of the reactive relay. 1Kvar is the value to be entered to the offset stage. While entering the value manually to this stage, we must divide 1Kvar by 3 (in order to enter value for each phase). The values of L1(R)=30 L2(S)=30 and L3(T)=30 should be entered.

After the offset stage is determined and the value of the offset stage is entered manually, the device will presume that such a load is constantly drawn from the system any more. The device will never use this stage. If you want to evaluate this stage later, switch the offset stage to off mode from the expert setting menu. Perform the stage test again after you connect a capacitor or shunt reactor to the offset stage.

23 - Response Resolution



Respond Rsltion
30

Figure-36

The device draws and releases more stages in order to respond to constantly changing loads in the system. This may shorten the lifetime of the contactors and capacitors. The response resolution is decreased and the device compensate with less stage switching in order to stop this.

When we increase the value of the response resolution, the device compensates more precisely by performing more stage switching.

24 - System Control

The device starts to intervene in the system after it finishes the current transformer and condenser tests. The device will draw the stage or stage groups based on the power drawn by the system. Interstage wait time is 300msec. while drawing the stage group.

If it is written inductive on the counter and the capacitive values is below the limit value, increase the capacitive set value and decrease the inductive set value. Increase the value if the device still shows inductive despite of waiting from 15 min. Repeat this process until it reaches the capacitive limit value. As the device works as capacitive based, its better intervening in inductive depends on high capacitive set value. Check if there is any load connected before the current transformer, if it goes on. If there is no problem with the connections and the system has sudden load variations, check the number of contact use and add stage having the same value with the most used stage. And also, add the condenser values required according to the power flow graph.

If it is written capacitive on the counter, decrease the capacitive set values and increase the inductive set value. Check the counter after waiting for 15 min. If it is still written capacitive on the counter, repeat this process until it falls below the limit value. If your system does not allow this, check if there is any load connected before the current transformer. If there is no problem with the connections, ass the reactor value required according to the power flow graph.

If there is rate difference between the reactive and counter, there may be a connection made to a load between the current transformers connected to reactive and the counter current transformers. If any, make this connection after the reactive current transformers. If the distance between the compensation panel and counter panel, the cable may cause capacitive effect. If it does not cause capacitive penalty, there is no need to intervene in. But it causes penalty, then you may need to connect shunt reactor as much as the difference between them or carry the compensation panel near the counter panel.

If there are capacitors out of order, change them for better compensation and retest the relevant stage from the menu. After the tests are completed, the device will start compensation automatically.

25 - Problems likely to Occur in the Systems

Unbalanced Powers in the Phase: If the powers in the phases are unbalanced, try to balance the power distribution in the system or add the stages suitable for the unbalanced phases from the power current graph.

Systems with Harmonic: The devices forming harmonic such as inverter, electronic balances affect the power factor negatively. It is required to use the harmonic filters in the systems.

Sudden Load Changes: If there are reactive powers changing quickly in the system, reduce the condenser intervention time and capacitor discharge time of the device. The device responds the system very quickly. This situation may cause the lifetime of the condensers and the contactors shorten. Using discharge coils for the contactors saves a few seconds. Add stage having the same value with the intensely used stages by checking the number of contact uses.

Selecting Suitable Condenser Values: It is recommended to connect the capacitors having intermediate values at stages in order to enable the device to intervene in different powers.

Example: The capacitor combination suitable or not suitable for using in as system of about 100Kwatt is as below. It is designated based on a three-phase capacitor of 60Kvar.

Table-4

Stage	1	2	3	4	5	6	7	8	9
Not Recommended	25KVar	15KVar	10KVar	5KVar	5KVar	2,5KVar			
Recommended	20KVar	15KVar	10KVar	7,5KVar	5KVar	2,5KVar	1,5KVar	1KVar	0,5KVar

Failing to perform current transformer test: The phases to compensation may have been connected before the current transformer. The may be loose contact in transformer connection. There may be loose contact in the feeds of the compensation. The stage capacitors may be out of order. There may be sudden load changes in the system. At least one of the current transformers may be faulty.

Performing Stage Test: Phases of the stage measured may be connected before the current transformer. There may be loose contact in the feeds of the compensation. Stage capacitors may be out of order or wasted. Current transformer may be faulty. Sudden load changes in the system may cause this test to last longer. You can enter stage value manually during the test.

26 - Maintenance of the Device

De-energize and disconnect the device. Clean the body of the device with a damp-dry or dry cloth. Do not use conducting or chemical materials likely to damage the device to clean. After the device is cleaned, complete the connections of it and make sure that the device is working by energizing it.

27 - Dimensions

Figure-62: Threaded Sidelobe (Apparatus)

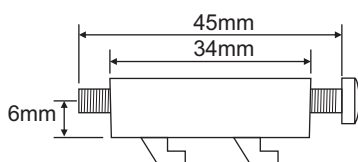


Figure-63: Sidelobe (Apparatus)



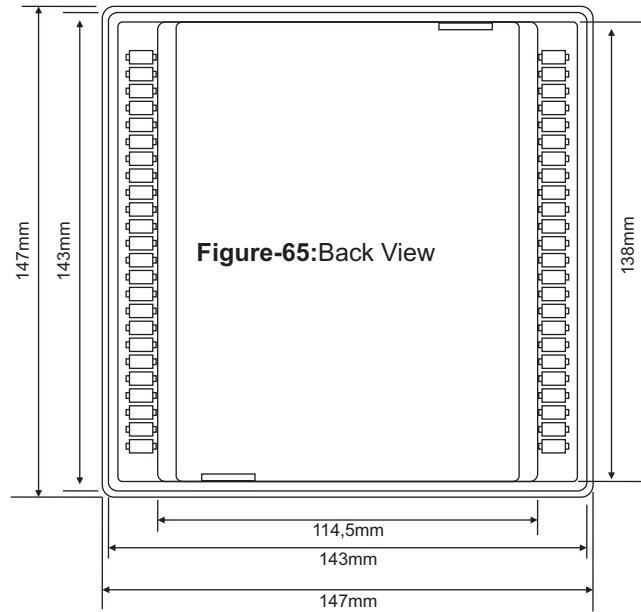
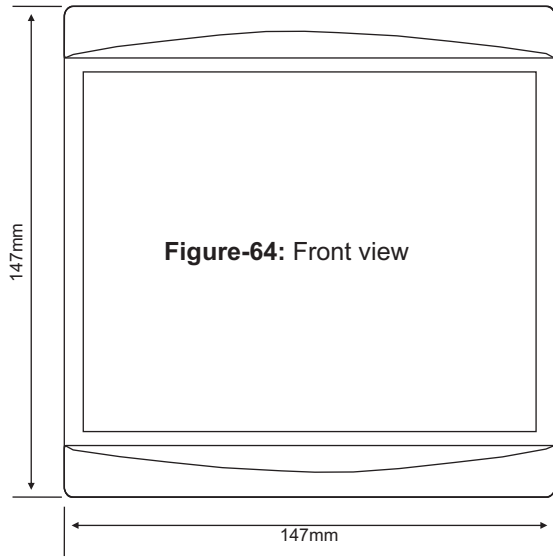
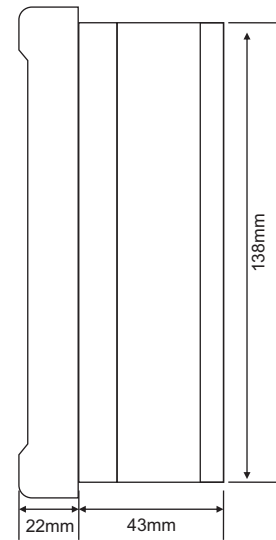
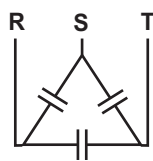
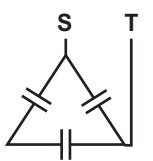
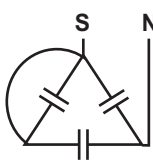
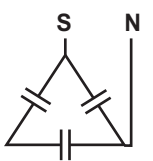


Figure-66: Left Side Back



28 - Spreadsheet of Connection Type-Based Capacitor Values

Table-4

				
Capacitor Power	3 Phase Connection (Q/3)	2 Phase Connection (Q/4)	Phase-Neutral Bridge Connection (2xQ/9)	Phase- Neutral Connection (Q/6)
0,5 KVAR	0,16 KVAR	0,12 KVAR	0,11 KVAR	0,08 KVAR
1 KVAR	0,33 KVAR	0,25 KVAR	0,22 KVAR	0,16 KVAR
1,5 KVAR	0,5 KVAR	0,37 KVAR	0,33 KVAR	0,25 KVAR
2,5 KVAR	0,83 KVAR	0,62 KVAR	0,55 KVAR	0,41 KVAR
5 KVAR	1,66 KVAR	1,25 KVAR	1,11 KVAR	0,83 KVAR
7,5 KVAR	2,5 KVAR	1,87 KVAR	1,66 KVAR	1,25 KVAR
10 KVAR	3,33 KVAR	2,5 KVAR	2,22 KVAR	1,66 KVAR
15 KVAR	5 KVAR	3,75 KVAR	3,33 KVAR	2,5 KVAR
20 KVAR	6,66 KVAR	5 KVAR	4,44 KVAR	3,33 KVAR
25 KVAR	8,33 KVAR	6,25 KVAR	5,55 KVAR	4,16 KVAR
30 KVAR	10 KVAR	7,5 KVAR	6,66 KVAR	5 KVAR

29 - Communication and Modbus Address

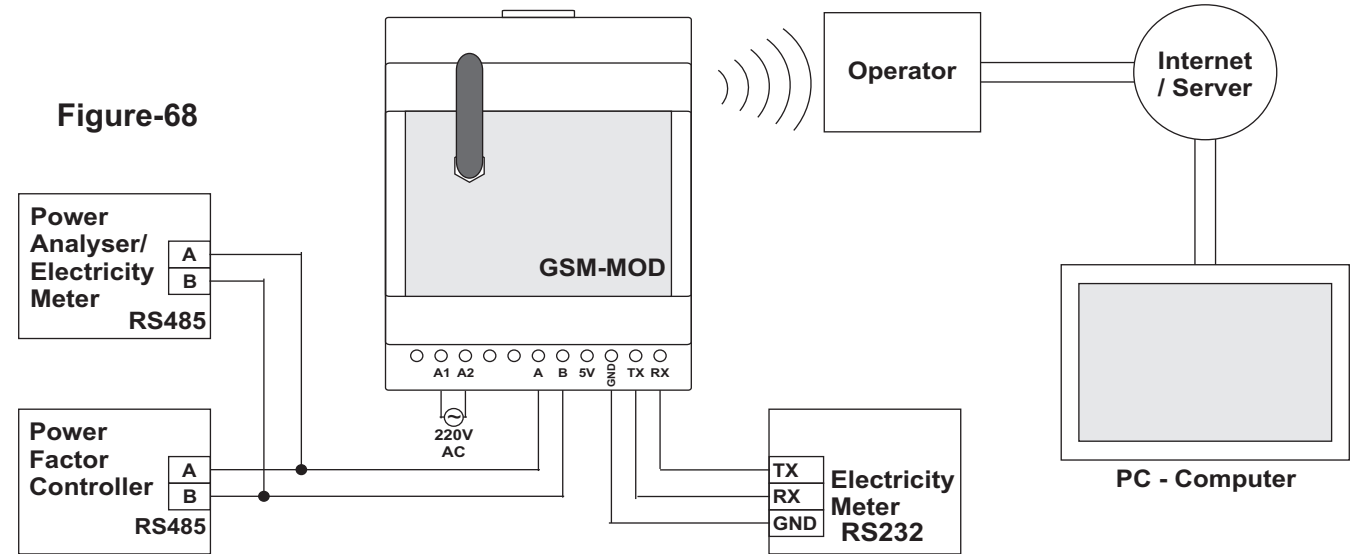


Figure-67

If there are minimum two devices (counter, reactive relay, energy analyzer etc) on Rs485 connection of GSM or Ethernet modem, information such as the serial number or modbus address is required for the modem to recognize the device.

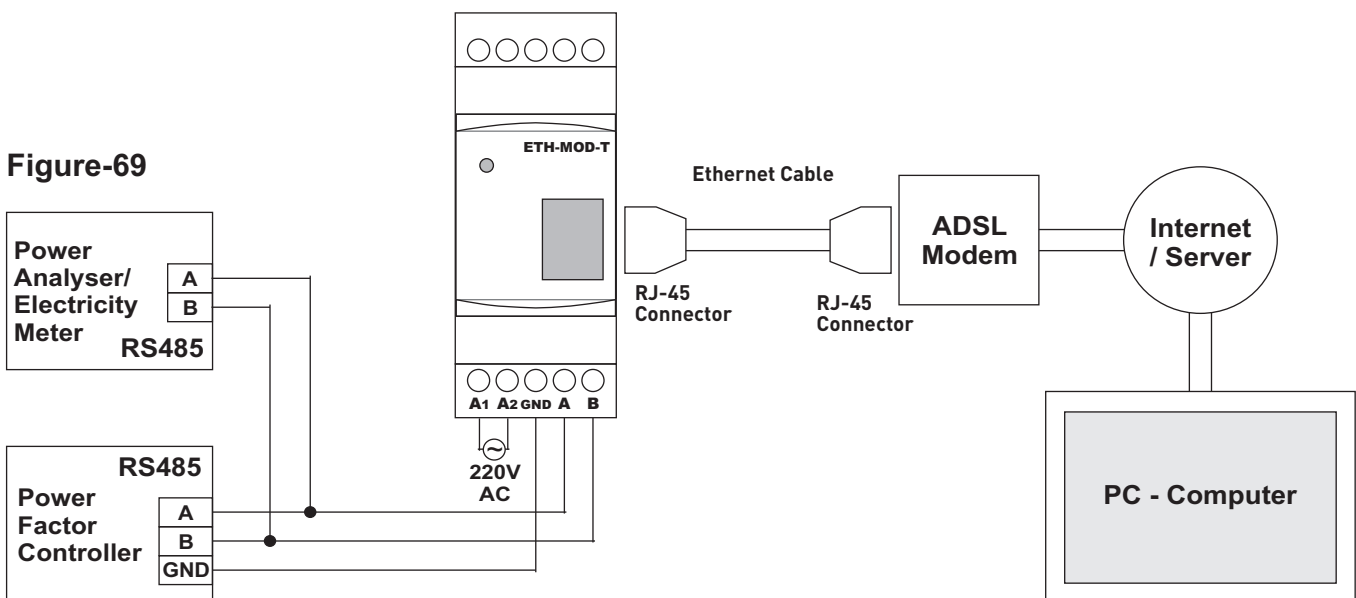
You can designate the modbus address of the reactive relay from the menu. If the modeme Rs485 line has only one reactive relay, you don't need to change the modbus address. 8-digit serial number is fixed on the counters. If you will connect more than one reactive relay to the modem, then make sure that the modbus addresses are same. Otherwise, bad data occurs. The values Baud rate=9600bps, Databit=8, Stopbit=1 and Parity=None are fixed on the reactive relay with regard to communication.

30 - Remote Communication with GSM-MOD



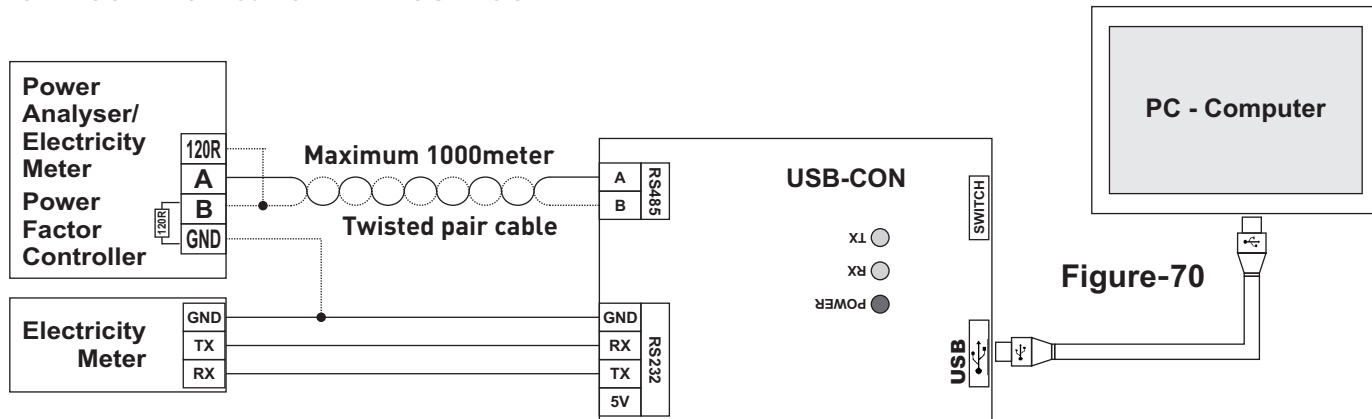
Only the reactive relay or the counter and energy analyzer can be connected for remote communication with GSM-MOD. Remote communication can be realized with reactive relay (counter or energy analyzer) over www.tenseenerji.com (Server) by using the data line of 100MB (recommended) from GSM operators.

31 - Remote Communication with ETH-MOD-T



Only the reactive relay or the counter and energy analyzer together with it can be connected for remote communication with ETH-MOD. Remote communication can be realized with reactive relay(counter or energy analyzer) over www.tenseenerji.com (Server) by connect to a modem having internet access

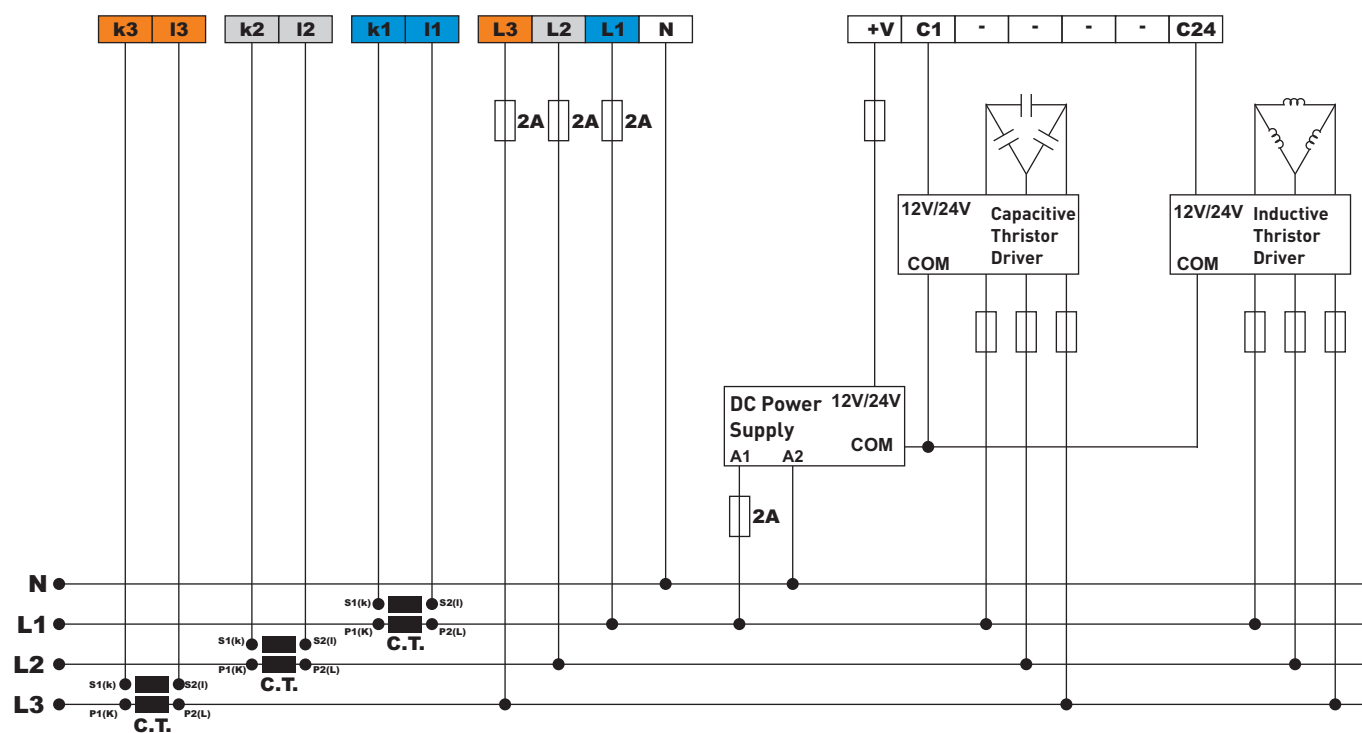
32 - Communication with USB-CON



Only a single device can be connected for communication with USB-CON. Communication is realized by using USB cable at about 1000 meters-distance (the distance may shorten based on the length of the cable). Communication with RGT-COM software is possible.

33 - Thristor Triggered Connection Chart

Figure-71



Thristor triggering is use with DC+V(12V/24V) instead of contactor triggering with dry contact in RGT-XX (T)X models. A DC power supply source (12V 1.2A or 24V 1,2A) suitable for the driver is required to trigger the thristor drivers. It connects to the (-) terminal of DC power-supply source and COM terminal of thristor drivers . (+) terminal of DC power supply source connects to +V inlet (common triggering end) of the reactive relay. (+) terminals of the thristor drivers connect to the stage (C1..C24) outlets of reactive relay.

Intervention and condenser discharge times fall down to 0,1 sec.

Thristor triggered systems are used where faster intervention is required.

It extends the lifetime of condensers.

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34 - Technical Specifications

Rated Voltage	160V - 240V AC
Operating Frequency	50 / 60 Hz
Operating Power	<12VA
Operating Temperature	-20°C.....55°C
Current Measurement Range	5mA - 5,5A
Measurement Sensitivity	%±1
Current Transformer Ratio	5/5A.....10000/5A
Connection Type	Pluggable Terminal
Relay Contactor	5A / 250V AC Resistive Load
Triggering Output	<30V DC / <40mA
Connection Isolation	2,5kV
Connection Speed	9600bps
Communication Values	Datab.:8, Stopb.:1, Parity:None
Connection Interface	RS485
Display	2x16LCD, 4 digit display, leds
Cable Diameter	2.5mm ² (Current and Voltage Inputs) 1.5mm ² (Stage Outputs)
Stage Number	8, 12, 18, 24
Mounting	Front-mounted to the panel
Operating Altitude	<2000metre
Weight	<900Gr.
Protection Class	IP41(Front Panel),IP00(Body)
Panel Hole Sizes	140mm x 140mm

36 - Contact Information

www.tense.com.tr info@tense.com.tr

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