

POWER-15 SVC

3-PHASE NEW GENERATION THYRISTOR CONTROLLED REACTOR / STATIC VAR COMPENSATOR (TCR/SVC) REACTIVE POWER CONTROL RELAY USER MANUAL



Note: The device screen images in this manual show the Turkish interface. The device language can be changed to English in Menu > Other Settings > Language.

1. Getting Started with the POWER 15-SVC

Introduction:

The Power series of reactive power control relays has been developed to solve all kinds of compensation requirements: three-phase or single-phase, medium voltage or low voltage, balanced or unbalanced loads, normally varying or rapidly varying loads, places where an SVC is needed, and similar cases. The Power 15-SVC is the new generation SVC relay of this family, developed for the most complex systems. In addition to 12 contact outputs, it has 3 reactor trigger outputs. With the Power thyristor driver modules connected to the reactor trigger outputs, it divides 3 reactors into thousands of slices and performs compensation with excellent precision. All operations are carried out with fast 20 ms measurements.

The Power 15-SVC and the Power driver modules work together in perfect harmony. Six different SVC modes are offered to the user. For example, the SVC system can be activated only on capacitive load, or only when the hourly ratios are in penalty. It can operate synchronously or asynchronously with the normal steps. Synchronous operation means co-compensating together with the normal steps. Asynchronous operation means clearing what is left over after the normal steps. More details are given in the settings section.

While the Power family was being developed, every feature users might need was considered, and the whole family is equipped with superior standard features and capabilities. Optionally, every model has a fully functional communication port. In models with communication, all kinds of data can be read, written and controlled without exception.

Foremost among the standard features are the rich analyzer capabilities. More than a hundred parameters are measured precisely and presented to the user on convenient measurement screens, including: sensitive measurement starting from 5 mA, measurements with 0.2% accuracy, current and voltage harmonics up to the 63rd harmonic, hourly-daily-weekly-monthly energy ratios, tariff energies, per-phase energies and per-phase energy ratios, import-export-inductive-capacitive-apparent energies, neutral current, per-phase currents-voltages-powers, power factors, and $\cos\Phi$ values.

Another standard feature is the connection test. The connection test is performed quickly and safely by connecting a three-phase capacitor to the first step. It detects not only polarity errors but also phase crossovers and corrects them automatically internally. If there is no error in the connections, it gives a confirmation. In cases where physical correction is required, such as current transformer terminals being crossed, it helps the user by giving a warning. If there is no voltage or no current, it warns by indicating on which phase or phases it is missing; so the relay does not merely say "connections wrong" or "connections correct": it corrects correctable errors automatically and also reports errors that must be corrected physically.

Another standard feature is the step test. With the fast and reliable step test, the relay learns the capacitors and reactors connected to its steps. The step test is faster with no load. When learning steps under load, so as not to be affected by changes in the load, the step test may take a few minutes depending on the load. The relay has smart algorithms for reliable step learning even under load. It learns the capacitors and reactors connected to its steps according to their phases. It is not affected by voltage fluctuations.

In addition, the steps are monitored continuously during compensation, and at a periodically set time, daily or weekly, all steps are tested again together. In this way, changes occurring in the steps do not disturb the operation of the system.

Event logging and recommendations are among the other prominent standard features. With the real-time clock, the last 10 important events are recorded. By analyzing the 24-hour values, the capacitors and reactors the system needs are recommended. Hourly and daily recommendations are produced continuously.

The Power family has many features as standard, such as alarms, language selection, password protection, generator input, temperature alarm, a separate compensation target activated by generator or digital input, and the ability to enter the compensation target in three different ways.

All Power series relays have smart intervention and smart timing algorithms. By recognizing the steps, they are switched in and out immediately or with a slight delay according to the needs of the system. This delay is determined by many criteria and protects the life of contactors and capacitors. Equal-aging is achieved by switching equal steps an equal number of times. Timings can also be selected as fixed values. For reactors, timing and switching are carried out differently from capacitors.

The menus of the Power family are designed with a wide graphic display so that users can operate them comfortably. The menus are organized and clear. Menus, alarms, settings and errors are written clearly in the selected language.

The Power family has been designed with years of experience, keeping what the user directly wants in the foreground, and updates will continue according to new needs that may arise over time. The main aim is to produce adequate and practical solutions to all compensation problems with a single family.

Selection Table:

In the Power series of reactive power control relays, there is always a solution for every need.

Model	Standard Measurements 3-phase currents I_{L1}, I_{L2}, I_{L3} Neutral current IMP 3-phase voltages U_{L1}, U_{L2}, U_{L3} 3-phase phase-phase voltages $U_{L12}, U_{L23}, U_{L31}$ 3-phase active powers P_{L1}, P_{L2}, P_{L3} 3-phase reactive powers Q_{L1}, Q_{L2}, Q_{L3} 3-phase apparent powers S_{L1}, S_{L2}, S_{L3} 3-phase power factors $PFL1, PFL2, PFL3$ 3-phase $\cos\phi$ $\cos\phi_{L1-L2-L3}$ Frequency Fr Total active power ΣP Total reactive power ΣQ Total apparent power ΣS Minimum and maximum values (of current, voltage and powers) 0.2% accuracy	Energies Import kWh L1-L2-L3- Σ Export kWh L1-L2-L3- Σ Reactive kVarh L1-L2-L3- Σ Inductive kVarh L1-L2-L3- Σ Apparent kVAh L1-L2-L3- Σ Tariff Energies (day, peak, night T1,T2,T3) Generator Energies (with generator input) Harmonics Current harmonics L1-L2-L3 Voltage harmonics L1-L2-L3 THD, 3-63 odd harmonics, 2-62 even harmonics Ratio display screens Bar graph display screens Energy Ratios Instantaneous ratios percentage $\tan\phi$ Hourly ratios Daily ratios Weekly ratios Monthly ratios Billing cut-off date adjustable	Display	Current and voltage harmonics 2-63	5 mA minimum measuring current	Connection correction	Polarity correction	Step learning and monitoring	Capacitor and reactor recognition	Step equal-aging	Switching and time counters	Recommendations	Smart intervention and timing	Target entry in 3 ways	20 ms measuring speed	Password protection	English / Turkish setting	Temperature measurement and alarm	Digital input (Generator target)	Alarm/fan output	RTC and event log
Power 18K	✓	✓	G	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Power 18KS	✓	✓	G	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Power 18TSC	✓	✓	G	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Power 18H	✓	✓	G	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Power 8HV	✓	✓	G	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Power 12M	M	M	G	M	✓	-	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	-	-
Power 12MS	M	M	G	M	✓	-	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	-	-
Power 15TCR	✓	✓	G	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓

M: single-phase, G: graphic display

Areas of Use:

Compensation is specific to the installation. Although different installations have different needs, all installations can be solved with a few generalizations. The relay solutions needed according to installation type are as follows:

1. Compensation relay with contactors.
2. Compensation relay with thyristor switching.
3. Compensation relay with contactors and SVC outputs (thyristor phase-angle controlled reactor).

As seen in the selection table above, relay models are offered in the Power series for all these solutions. The subject of this manual is the Power 15-SVC NEW GENERATION three-phase reactive power control relay model.

The Power 15-SVC relay achieves excellent results even in complex installations where loads are unbalanced, sometimes small and sometimes large, and fast-changing. It compensates the installation's power precisely, as if there were thousands of capacitors and reactors.

The SVC relay can be used in every type of installation; we recommend it as the definitive solution for every kind of installation, not only for problematic ones but also to avoid problems in the future:

All industrial 3-phase installations

Factories

Petrol stations

Supermarkets

Banks

Schools

Automotive industry panels

Buildings

Housing complexes

Government offices

Hotels

Welding workshops

Press machines

Elevators

Cranes

Loads that switch on and off very fast

Balanced-unbalanced, large and small loads

Measured Network Parameters:

The Power relay series measures precisely all the network parameters users may need, saving its valued users time, space and cost. These measurements are presented on convenient, carefully prepared screens for easy analysis.

The parameters measured and displayed with the Power family are as follows:

MEASURED NETWORK PARAMETERS

Voltages

Phase-phase voltages

Phase currents

Neutral current

Phase active powers

System active power

Phase reactive powers

System reactive power

Phase apparent powers

System apparent power

Phase $\cos\phi$ values

Phase power factors

System power factor

Frequency

Minimum values

Maximum values

Phase energies

System energies

Generator energies

Tariff energies

Energy ratios

Current Harmonics

Voltage Harmonics

All these parameters are measured precisely, displayed regularly, and those required are saved to non-volatile memory.

Power 15-SVC Technical Specifications;

Auxiliary Supply	230V (+-20%) Optional: 57VAC,100 VAC For other special supply types, please contact our company.
Supply circuit power consumption:	<6 VA
Voltage Measurement Inputs	10-600VAC
Current Measurement Inputs	.../5A (5/5...10000/5)
Frequency:	50 Hz
Measurement input power consumption:	< 0.5VA
L-N in:	344 VAC 50 Hz.
L-L in:	600 VAC 50 Hz.
Overcurrent Withstand	50A 1 s, 10A continuous (Relay Measurement Inputs)
Current Measurement Secondary	5mA...6A
Current Measurement Primary	Up to 12000A (with suitable current transformer)
Current Measurement Accuracy	0.2%
Voltage Measurement Accuracy	0.2%
Apparent Power Accuracy	0.2%
Active Power Measurement Accuracy	0.5%
Reactive Power Measurement Accuracy	0.5%
Current Harmonic Measurement	2,3,4,5,...,60,61,62,63 and THD
Voltage Harmonic Measurement	2,3,4,5,...,60,61,62,63 and THD
Measurement input power consumption:	< 0.5VA
Connection type:	3P4W
Contacts	5A
Operating temperature:	-5...+55°C
Dimensions	144x144x80 mm
Panel Cut-out Width	136x136 mm
Display	3.4" Graphic LCD

Commissioning

The phase order and direction are not important in the voltage and current connections. When the connection test is performed, the relay corrects the connections automatically from within. Nevertheless, we recommend connecting the phases in the correct positions and making it a habit.

The neutral (Mp) connection must be made correctly and must not be confused with the phase voltages.

Even if the current transformer terminals are connected to the wrong phase, the relay corrects these errors together with polarity errors in the connection test. However, if cables coming from separate current transformers are crossed with each other, this can only be corrected physically.

The current transformer terminals must be tightened especially firmly. Poor contact can cause unwanted damage.

Connections must not be disconnected while energized.

The first step should be a three-phase capacitor; a large three-phase capacitor will make the connection test easier.

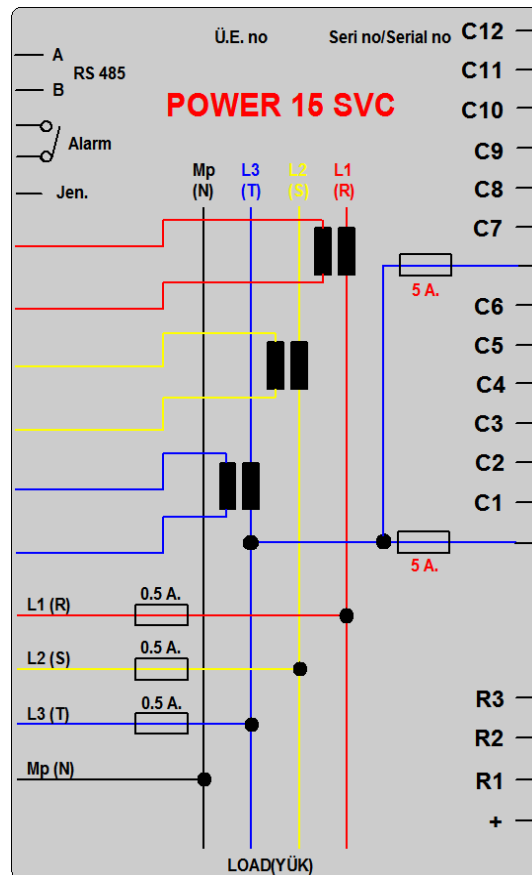
B. WARNINGS

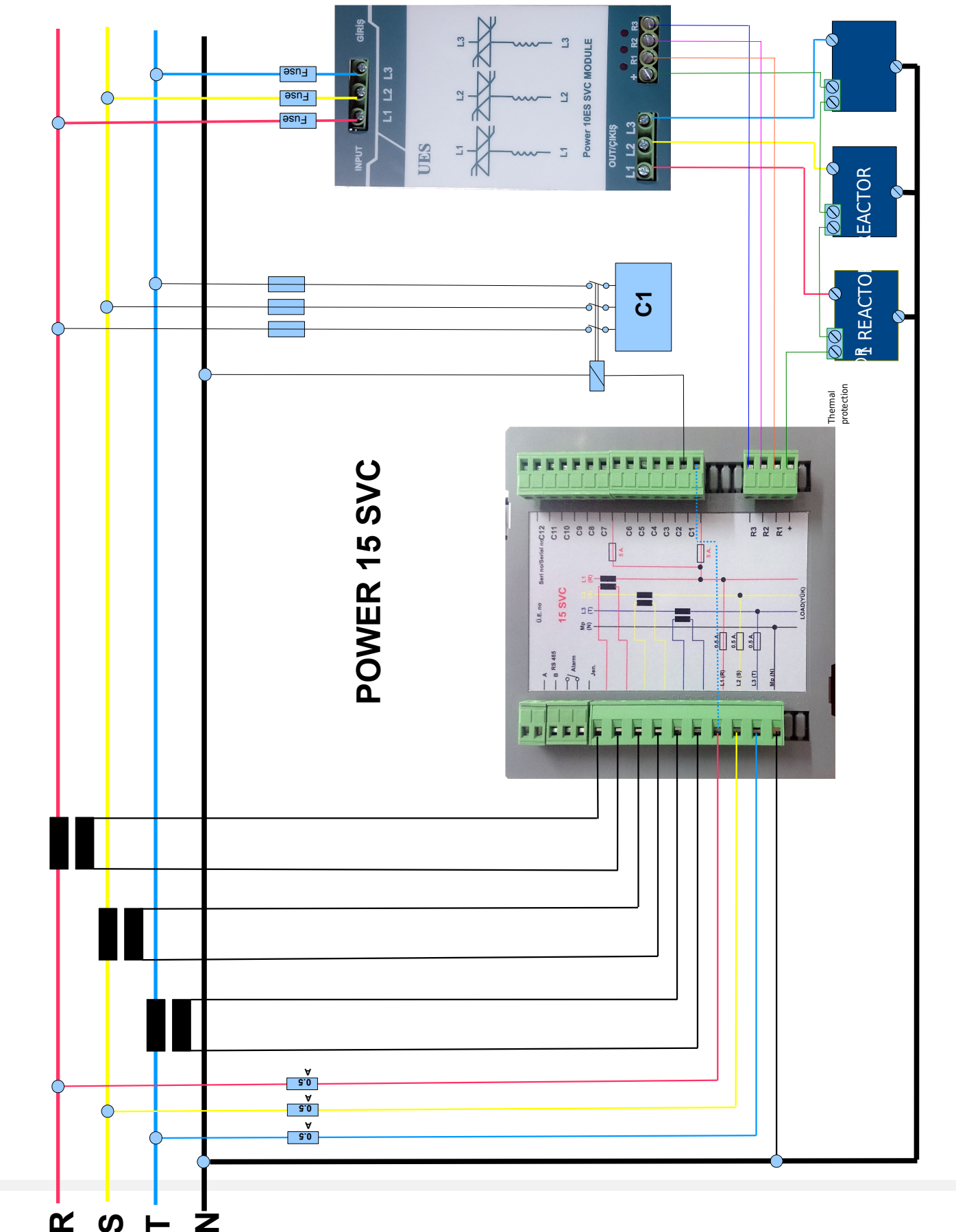
WARNINGS !!! 1. The current transformer terminals must never be left open-circuit! 2. Connections must not be disconnected while energized! 3. Before energizing the device, always check the connections! If any connection in the terminals is loose, correct it!

4. Always cut the power before making corrections!

There are no user-serviceable parts in the device. If you experience a technical problem, please contact us.

A. Connection Diagram

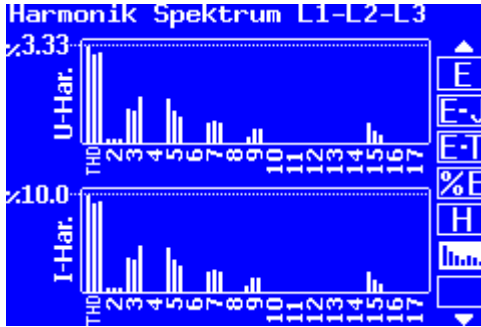
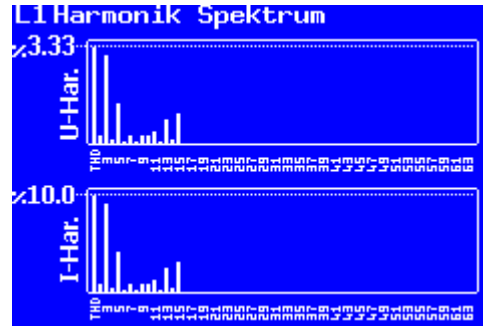




Measurement Screens:

Measurement Screens Map:

In the Power relay series, the measured network parameters are shown in the following order with the "up", "down" and "set" keys. The "set" key brings up the other parameters related to the current screen. Pressing the "set" key for a long time enters the menu.



Kademe izlem (Tümü)

1	2	3	4	5	6	7	8	9
3.33	0.00	3.33	3.33	1.00	1.00	1.00	1.00	

10	11	12	13	14	15	16	17	18

Kademe izlem (1-8)

1	2	3	4
10.00	1.00	10.00	10.00
3.33	1.00	3.33	3.33
3.33	0.00	3.33	3.33
3.33	0.00	3.33	3.33
999999999	99	999	99
999999999	9:59	99:59	9:59

5	6	7	8
10.00	1.00	10.00	10.00
3.33	1.00	3.33	3.33
3.33	0.00	3.33	3.33
3.33	0.00	3.33	3.33
502	4	33568	254
14:24	0:15	250:26	10:01

32°C RX TX

ΣPF **-0.994**

ΣP **345.3 kW**

ΣQ **- 21.2 kVAr**

ΣS **345.9 kVA**

L1 **234.0 V 100.0 A**

L2 **234.0 V 100.0 A**

L3 **234.0 V 100.0 A**

AVLIK ORAN

23:59 31.12.2012

32°C RX TX

ΣPF **-0.994**

ΣP **345.3 kW**

ΣQ **- 21.2 kVAr**

ΣS **345.9 kVA**

L1 **1.123k**

L2 **3.524k**

L3 **2.678k**

AVLIK ORAN

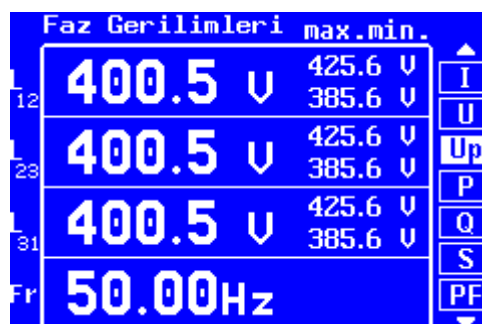
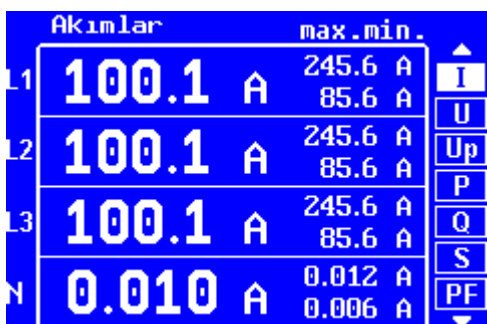
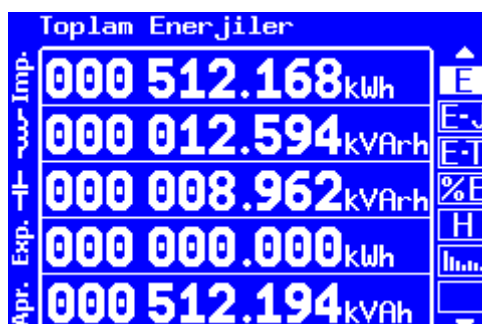
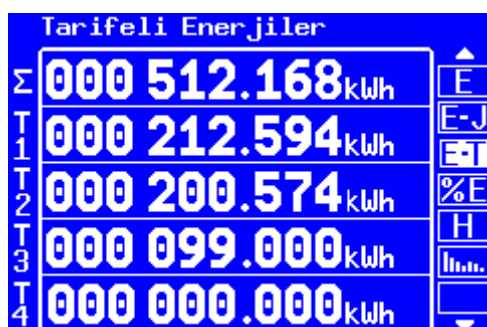
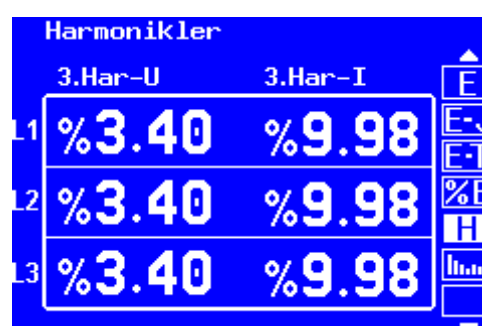
23:59 31.12.2012

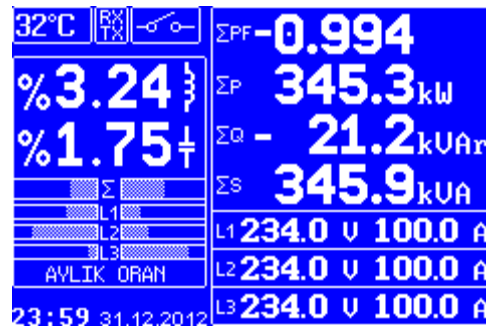
Gerilimler max.min.

		max	min
L1	234.5 V	245.6 V	205.6 V
L2	234.5 V	245.6 V	205.6 V
L3	234.5 V	245.6 V	205.6 V
Fr	50.00 Hz		

Güç Faktörleri cosφ

		max	min
L1	-0.998	-0.997	
L2	-0.998	-0.997	
L3	-0.998	-0.997	
Σ	-0.998		



Main Screen:

The information most needed is shown on the main screen. The percentage reactive ratios can be monitored as instantaneous, monthly, hourly, daily and weekly. The previous hourly-daily-weekly-monthly ratios can also be monitored. The monthly ratio is the ratio of the energy meters recorded since the last billing cut-off date. It is reset at the end of the month and is then seen as the old monthly ratio. The previous monthly ratio is the old monthly ratio recorded from the beginning of the previous month to its end. The billing cut-off date can be changed from the menu. The total ratios are shown in large print. Under the text, 8 symmetrical bars show in which region the energy ratios accumulate. According to the picture in the example, the capacitive energy on phase L2 has accumulated much more than on the others, and the inductive energy on phase L3 has accumulated much more than on the other phases. When the user looks at the device from the front, the user's right shows the inductive side and the left shows the capacitive side. The information shown on all screens shows the real values on the primary side when the current and voltage transformer ratios are set correctly. All of these measurements are displayed with automatic floating point and automatically adjusted kilo-mega units, in a form and at a speed that the user can read comfortably.

Information shown on the main screen:

1. Total power factor: The power factor calculated from the resultant of the 3 phases of the system. At the top left of the screen.

2. Total active power: The total working, active power drawn from the 3 phases of the system. It is directional. A minus sign indicates that the system is exporting energy. If the system is one that only consumes energy, as is generally the case in compensated systems where energy is taken and not produced, negative active power means that the connections were made wrongly and the connection test was not performed. These errors can be corrected automatically by the relay by performing the connection test from the menu. The total active power is shown at the top left, in second place. It is denoted by the Sigma and P symbols. Sigma means total.

3. Total reactive power: Shown at the top right, in third place, denoted by the Sigma and Q symbols. It shows the total reactive power produced and consumed by the system, with direction. If a minus sign appears, the system is capacitive overall; otherwise it is inductive. During compensation, it varies in both directions around the target according to load changes. Sometimes one of the phases may be capacitive and another inductive. In such cases, the total reactive power will be shown in the direction of the larger phase. Each phase can be examined individually on the reactive powers page.

4. Total apparent power: The sum of the Volt-Ampere apparent power values flowing from the three phases of the system. At the left in fourth place, denoted by the Sigma and S symbols.

5. L1-L2-L3 voltages and currents: They are in the bottom row on the right. The six basic parameters of the system can be monitored at a glance.

6. Temperature: Can be monitored at the top left in degrees Celsius.

7. RX-TX: In models with communication, it gives information about the port status during communication.

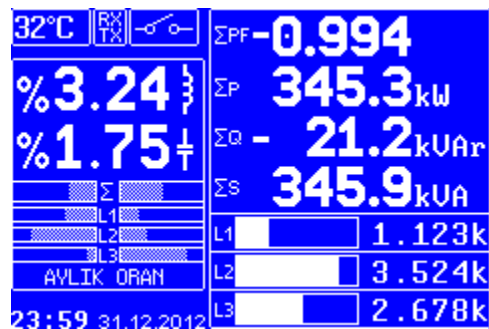
8. Alarm/Fan contact information: The status of the alarm contact on the relay, other than the step contacts, can be monitored here.

9. System total energy ratios: Reactive ratios, inductive and capacitive, are shown as percentages in large print on the left. While on this screen, it is possible to browse between instantaneous-monthly-weekly-daily-hourly ratios with the "set" key.

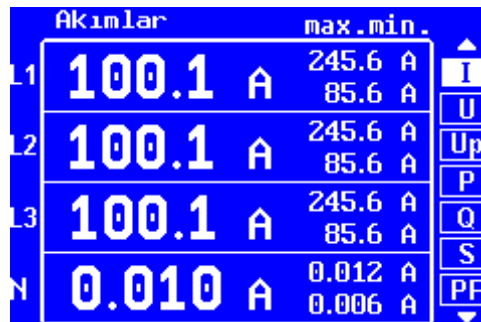
10. Energy ratio bars: Shows how much of the reactive ratios in the system originate from which phases. These bars are also drawn separately according to the hourly-daily-weekly-monthly-instantaneous ratio. The right of the screen is the inductive side, the left is the capacitive side.

11. Calendar and clock: The real-time clock and calendar information is shown at the bottom right of the screen.

While on the main screen, by pressing the "esc" key, you can choose between the screen showing whether the reactors are in circuit and the current-voltage screen:



Currents:



This screen shows the currents per phase and the neutral current. At the same time, the maximum and minimum values can be monitored at a glance. When the "set" key is pressed on the current screen, the phasor flow diagram appears:



On the phasor flow screen, the angles between phase voltages and currents and the power flow directions are monitored.

Voltages:

Gerilimler		max.min.	
L1	234.5 V	245.6 V 205.6 V	▲ I U Up P Q S PF ▼
L2	234.5 V	245.6 V 205.6 V	
L3	234.5 V	245.6 V 205.6 V	
Fr	50.00Hz		

This screen shows the phase-neutral voltages and the frequency. At the same time, the maximum and minimum values can be monitored at a glance.

Phase-to-Phase Voltages:

Faz Gerilimleri		max.min.	
L12	400.5 V	425.6 V 385.6 V	▲ I U Up P Q S PF ▼
L23	400.5 V	425.6 V 385.6 V	
L31	400.5 V	425.6 V 385.6 V	
Fr	50.00Hz		

This screen shows the voltages between phases and the frequency. At the same time, the maximum and minimum values can be monitored at a glance.

Active Powers:

Aktif Güçler		max.min.	
L1	115.5 kW	245.6 kW 205.6 W	▲ I U Up P Q S PF ▼
L2	115.4 kW	245.6 kW 205.6 W	
L3	115.3 kW	245.6 kW 205.6 W	
Σ	346.2 kW	736.8 kW 616.8 W	

This screen shows the active powers per phase and the total active power. At the same time, the maximum and minimum values can be monitored at a glance.

Active power measurement is directional. In systems that export energy, the (-) sign appears. If the system does not export energy and (-) active power is displayed, the current transformer directions of the phases with the minus sign are connected in reverse. This must be corrected. To use the automatic correction feature by performing the connection test, see the menu.

Reactive Powers:

Reaktif Güçler		max.min.	
L1	2.155 kVAr	20.01k 100.3	I
L2	2.154 kVAr	20.01k 100.3	U
L3	2.153 kVAr	20.01k 100.3	Up
Σ	6.462 kVAr	20.01k 100.3	P
			Q
			S
			PF

This screen shows the reactive powers per phase and the total reactive power. At the same time, the maximum and minimum values can be monitored at a glance.

In reactive powers, the minus (-) sign indicates capacitive, while no sign indicates the inductive direction.

While the system is running, each phase may be in the same direction or in different directions. Reactive energies are classified separately into the inductive and capacitive meters at 20 ms speed.

Apparent Powers:

Görünür Güçler		max.min.	
L1	120.0 kVA	250.7k 1.234k	I
L2	120.0 kVA	250.7k 1.234k	U
L3	120.0 kVA	250.7k 1.234k	Up
Σ	360.0 kVA	752.1k 370.2k	P
			Q
			S
			PF

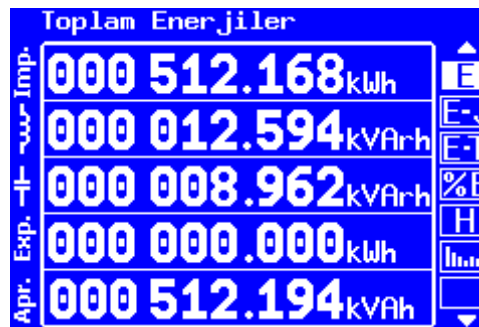
This screen shows the apparent powers per phase and the total apparent power. At the same time, the maximum and minimum values can be monitored at a glance.

Power Factors and $\cos\phi$ values:

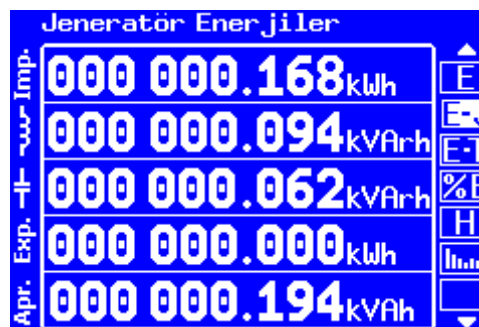
Güç Faktörleri		$\cos\phi$	
L1	-0.998	-0.997	I
L2	-0.998	-0.997	U
L3	-0.998	-0.997	Up
Σ	-0.998		P
			Q
			S
			PF

This screen shows the power factors and $\cos\phi$ values. Those with a minus (-) sign are capacitive; those without are inductive.

Depending on the harmonics in the system, the differences between $\cos\phi$ and power factors increase. While power factors are calculated from the ratios of active power and apparent power, $\cos\phi$ values are calculated taking harmonics into account as well. The power factor of the fundamental components is the $\cos\phi$ value.

Energies:

Total energies are shown on this screen. With the "set" key, the energies in phases L1-L2-L3 can also be viewed one by one. From top to bottom, import active energy (kWh), inductive reactive energy (kVArh), capacitive reactive energy (-kVArh), export active energy (-kWh) and apparent energy (kVAh) are shown separately, both in total and per phase.

Generator Energies:

When the generator comes into operation, if a signal has been applied to the digital input, the generator energies start counting. In this way, how much energy is taken from the generator can be analyzed separately.

Tariff energies:

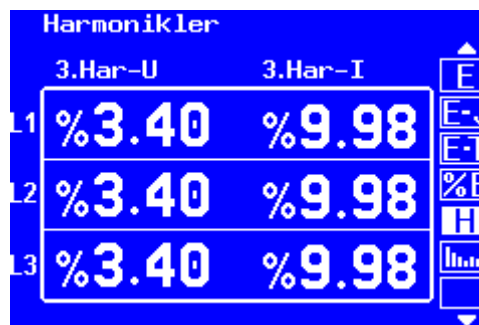
Using its built-in clock, the Power relays also count separately the active energy drawn in the day (T1), peak (T2) and night (T3) tariffs. This data can be used for meter testing and analysis purposes.

Energy Ratios:



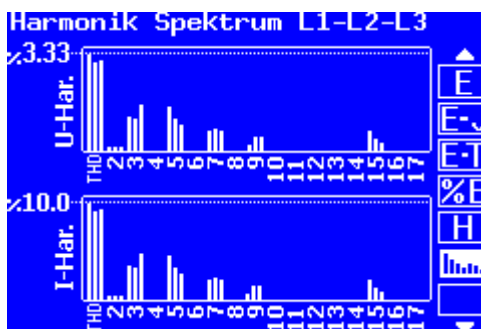
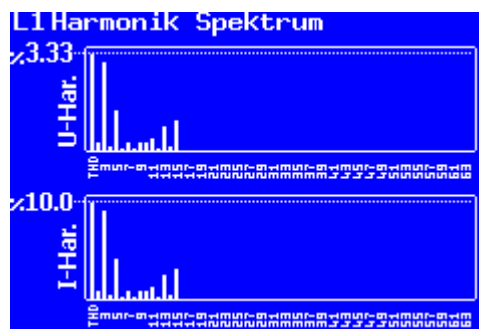
This screen shows the energy ratios. Inductive and capacitive energy ratios are shown together on the same page. With the "set" key, you switch between instantaneous-hourly-daily-weekly-monthly ratios and last hourly-last daily-last weekly-last monthly ratios. The last ratios are the old current ratios that have completed their full period. The current ratios are ratios that have just started according to the time period and the current time-calendar; they may be at the beginning, middle or near the end of the period.

Voltage and Current Harmonics:



This is the page that presents the harmonics of the currents and voltages for the 3 phases at the same time as percentage values. With the "set" key, you can browse through the harmonics THD-2-3-4-5-...-62-63.

Harmonic Spectrum:



On this screen, the spectrum of both voltages and currents, for all three phases at once, odd and even, up to the 17th harmonic, is shown as a bar graph. The harmonics most commonly seen in systems are the odd harmonics, and generally the largest are those up to the 17th harmonic.

Up to the 63rd harmonic, both voltage and current harmonics are presented in separate spectrum graphs per phase. For this, it is enough to browse with the "set" key:

Step Monitor:

Kademe İzlem (Tümü)																	
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+
3.33	0.00	3.33	3.33	1.00	1.00	1.00	1.00										

On this screen, all 18 steps can be viewed at once. What is connected to which step can be seen. For more detailed monitoring in groups of eight, it is enough to browse with the "set" key:

Kademe izlem (1-8)															
1				2				3				4			
10.00		3.33		1.000		1.00		10.00		3.33		10.00		3.33	
⊕		⊕		⊕		⊕		⊕		⊕		⊕		⊕	
3.33		3.33		0.00		0.00		3.33		3.33		3.33		3.33	
⊕ ⊕		⊕ ⊕		⊕ ⊕		⊕ ⊕		⊕ ⊕		⊕ ⊕		⊕ ⊕		⊕ ⊕	
3.33		3.33		0.00		0.00		3.33		3.33		3.33		3.33	
9999999999				99				999				99			
9999999:59				9:59				99:59				9:59			
5				6				7				8			
10.00		3.33		1.000		1.00		10.00		3.33		10.00		3.33	
⊕		⊕		⊕		⊕		⊕		⊕		⊕		⊕	
3.33		3.33		0.00		0.00		3.33		3.33		3.33		3.33	
⊕ ⊕		⊕ ⊕		⊕ ⊕		⊕ ⊕		⊕ ⊕		⊕ ⊕		⊕ ⊕		⊕ ⊕	
3.33		3.33		0.00		0.00		3.33		3.33		3.33		3.33	
502				4				33568				254			
14:24				0:15				250:26				10:01			

Ten items of information are presented in each of the eight groups. In each group box, at the top left is the step number, next to it in large print the total "kVar" power value of the step, below it from top to bottom the L1-L2-L3 "kVar" values, to the left of the values clockwise a symbol for the step's empty-capacitor-reactor information, and at the bottom how many times the step has been switched and for how many hours and minutes it has been kept in circuit.

Kademe izlem (1-8)				
2.kademe	2	1.000		Kademe toplam kVAR gücü
	+	1.00		L1-L2-L3 yukarıdan aşağı faz başına kVAR güçleri
	0.00	0.00		
		99		99 kez anahtarılmış
		9:59		9 saat 59 dakika devrede kalmış
saat yönünde L1-L2-L3 faz başına kademe bilgisi	6	1.000		
	+	1.00		
	0.00	0.00		
		4		4 kez anahtarılmış, 15 dakika devrede kalmış
		0:15		

Menu:

The settings of the Power 15-SVC analyzer are made with its clear and easy menu. The step test, connection test, energy and minimum-maximum-demand reset, return to factory settings, and resetting of step counters are also done with the help of the menu. Entry to the menu is password protected.

To enter the menu, press and hold the "set" key while on any measurement page. After the relay's 4-digit password is entered correctly, the main menu appears on the screen. To enter the password digits, the "up-down" keys are used. When the current digit is on the screen, the "set" key moves to the next digit. When the last digit is also entered, if the password is correct the main menu opens. If it is wrong, password entry returns to the first digit.

Default password: "0000".

The Main Menu has the following headings:

1. Quick Setup Wizard
2. Step Settings
3. Connection Settings
4. Compensation Target
5. Alarms
6. Recommendations
7. Other Settings
8. Event Log
9. Manual Test
10. Reset Menu

While in any menu, press the "esc" key to return to the upper menu. To return to the measurement pages and exit the menu completely, press and hold the "esc" key; or press the "esc" key one at a time and exit in two or three presses.

Entering the Menu:

While on any measurement page, it is enough to press and hold the "set" key. The Power 15-SVC will ask for the password:



The first digit of the password is selected with the "up" and "down" keys. After selecting, the "set" key moves to the next digit. After the four digits are entered, the menu is entered with the "set" key. If the password is entered

wrongly the menu is not entered; starting from the first digit, the four-digit password is requested again. While the digit currently to be entered is shown as the selected item, the other digits are hidden with the "*" character.

When the password is entered correctly, the main menu appears on the screen.

Main Menu:



In the main menu, the 10 menus of the Power 15-SVC relay appear one under the other on two separate pages.



In the example picture, as on first entry, the "Quick Setup Wizard" menu is shown as the selected item. The other menus are brought to the selected item view with the "up" and "down" keys. When the menu you want to enter is selected, the "set" key moves to the submenu.

Pressing the "set" key while in the selected item view opens the selected menu.

Quick Setup Wizard:



When selected from the main menu and entered with the "set" key, the menu content opens. The step count and current transformer ratio settings, which are most needed at the first commissioning of the relay, are made in this menu in order as the first two steps. In the third step, the relay gets to know the panel. The relay first switches the first step in and out, automatically recognizes the polarity and the L1-L2-L3 phase order, and corrects them if there is a wrong connection. If there is a physical error that the user needs to intervene on during this time, it gives a warning by indicating the location. When the connection test is completed, the relay proceeds to learn the steps. By switching the steps in and

out in order, the step connections, types and powers are learned. For the relay's compensation intervention algorithms to work reliably, it must know the steps correctly. For this reason, we recommend having the automatic test carried out from this menu or from the step test menu instead of manual setting.

1. Select the step count with the "up-down" keys and press the "set" key. If you will not use all 18 steps and have connected the steps in order, you can enter a number smaller than 18. If you have connected the steps in a scattered way, with only the first step being a three-phase capacitor, leaving the step count at 18 even if there are only 3 steps does not affect the operation of the relay. Apart from the learning process finishing in the shortest time, entering a large step count has no effect. However, if a small number is entered, the relay will not switch in or out the steps numbered above the step count. Therefore, either 18 must be entered, or if a smaller number is entered it must absolutely be correct.

2. Select the Current Transformer Ratio with the "up-down" keys and press the "set" key. For example, if there is a 600/5 current transformer, 120 is selected. Entering the current transformer value correctly is essential to see the primary values of step powers, measured parameters and energy indexes correctly. A mistake does not harm compensation, but the values will appear as secondary values. And it causes errors in manual settings.

3. By learning the connections and steps, the relay will get to know the panel. After selecting the current transformer ratio and pressing the set key, the text "LEARN>" will come to the selected item view. In this case, if the "set" key is pressed, the relay moves to the connection learning stage:

```
Bağlantılar Öğreniliyor
İlk kademe TRİFAZE KONDANSATÖR olmalı!

Kalan Tahmini Süre : 10sn

Lütfen Bekleyiniz ...
```

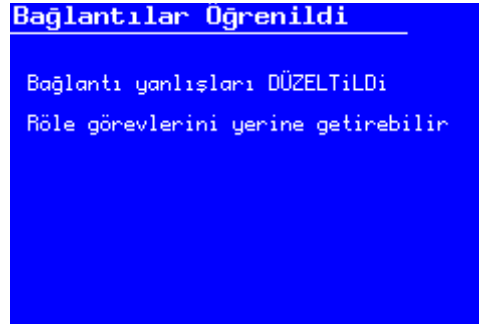
The connections are learned by switching the first step in and out. If an error occurs during the connections, a warning is given. If the connections are correct or have been corrected automatically, the following messages are given:

If the connections are already correct:

```
Bağlantılar Öğrenildi

Bağlantılar DOĞRU.
Röle görevlerini yerine getirebilir
```

If the connections have been corrected:



After the connections are learned, these messages are kept on the screen for a few seconds; then the relay proceeds to learn the steps:



Learning the steps takes between 18 seconds and 10 minutes depending on the load condition. When 10 minutes have elapsed, if there are still steps that could not be learned due to load movement, they can be entered manually from the step settings menu. Or a step learning scan can be run again from the step settings menu. If these are not done, while the relay automatically tests the steps at the set time, it will learn any steps whose learning remained incomplete. Under most load conditions, 10 minutes will be sufficient.



After the steps and connections have been learned, the relay will perform its measurement and compensation duties correctly. If the step powers are insufficient, the relay will make recommendations to the user. For the recommendations feature, see the relevant section.

After completing the three steps in the quick setup wizard, advanced settings can be made from the other menus if desired. For example, settings such as step switch-in/out times, periodic step learning time and billing cut-off day can be changed from the relevant menus if needed.

Step Settings:

When selected from the main menu and entered with the "set" key, the step settings appear on the screen. There are nine step settings; you can see and change all of them at once in this menu.

The "set" key moves to the next line/setting. With the "up-down" keys, the setting value on the line/selected item currently being edited is changed. After 9 settings are done, the "SAVE AND EXIT" operation is performed with the "set" key. If the "esc" key is pressed, it returns to the previous line/setting. If "esc" is pressed for a long time, the whole menu is exited.

1. Step Count: So as not to perform useless operations for unused steps, for example if 11 steps are used, this setting is selected as 11 and the 11 steps are connected to the first 11 contactor outputs; thus the relay is made to ignore the last three steps. Even if 3 steps are used, leaving this setting at 12/24 does no harm.

2. Learn Steps: Normally it is in the "auto" state when this setting is reached. If the "set" key is pressed, it moves to the next setting without changing the step values. If it is desired that the steps be scanned and learned automatically, "learn>" is selected and the "set" key is pressed, and the relay starts learning by scanning the steps. If it is desired to enter step values manually, to enter all or any one of them manually, "manual>" is selected and the "set" key is pressed. The relay then opens the setting page required for manual entry.

3. Capacitor switch-in time: For capacitor steps, the time elapsing from the intervention decision to the application decision. It can be set to automatic or a fixed time. It is in 100 ms steps. It can be set between 1 s and 100 s. The default value is automatic, and we recommend leaving it at automatic for compensation success and for the balance of contactor & capacitor life.

4. Capacitor switch-out time: For capacitor steps, the time elapsing from the intervention decision to the switch-out decision. It can be set to automatic or a fixed time. It is in 100 ms steps. It can be set between 1 s and 100 s. The default value is automatic, and we recommend leaving it at automatic for compensation success and for the balance of contactor & capacitor life.

5. Discharge Time: For capacitors to be switched in again after being switched out, the energy that may remain on them must have been discharged. For this, the recommendation of the capacitor manufacturers must be applied. If discharge coils are connected to all capacitors, we recommend setting this to automatic. With automatic discharge time, the relay calculates how discharge times vary with capacitor power and obtains the best result. Capacitor discharge time is important for system life, so where discharge coils are not used, it must be set to the time recommended by the capacitor manufacturer.

The discharge time can be set between 1 s and 500 s in 1 s steps. If discharge coils are used, setting it to automatic gives better results.

6. Reactor switch-in time: For reactors, the switch-in/out times are kept different from the times for capacitors. Frequent switching of reactors degrades power quality in the system. Therefore, whether left on automatic or a fixed time is entered manually, the relay will keep the reactor timing separate from the capacitor timing. If necessary precautions have been taken with the required filters, the switching time of the

reactors can be reduced to about 1 s. Automatic means that the relay determines the time itself according to the situation. It can be set between 1 s and 500 s in 1 s steps. The default value is automatic.

7. Reactor switch-out time: For reactors, the switch-in/out times are kept different from the times for capacitors. Frequent switching of reactors degrades power quality in the system. Therefore, whether left on automatic or a fixed time is entered manually, the relay will keep the reactor timing separate from the capacitor timing. If necessary precautions have been taken with the required filters, the switching time of the reactors can be reduced to about 1 s. Automatic means that the relay determines the time itself according to the situation. It can be set between 1 s and 500 s in 1 s steps. The default value is automatic.

To leave the determination of smart intervention times to the relay itself, we recommend setting all switch-in and switch-out times to automatic. The intervention times of the Power family are multi-dimensional and smart.

WARNING! If there is no sufficient discharge coil or resistor, enter the discharge time as specified by the capacitor manufacturer.

8. Periodic learning time: With this setting, you determine at which hour the relay's feature of automatically testing the steps at a certain time daily or weekly, and completing missing items or changes, will become active. For example, the relay was commissioned in the daytime under load and, because of excessive load movement, could not recognize a few of the small-power step groups. With this setting, at 01:00 at night when there is no load or the load has decreased, the relay can complete what is missing. Apart from this, while performing compensation the relay also continues to follow and learn the steps.

9. Periodic learning: Off, daily or weekly can be selected. If off is selected, the relay never performs a step learning test by itself. If daily is selected, the steps are tested every day at the set time. If weekly is selected, the steps are tested on Sundays at the set time.

Note: For the periodic step test, the compensation panel and the relay must be energized at that time. If there is no power at that time, that day or that week is skipped.

If the steps are to be entered manually:

While on the 2nd line of the step settings page, at the learn steps setting, "manual>" is selected and the "set" key is pressed. The relay then opens the setting page required for manual entry:

Elden Kademe Ayarı			
1	2		
3	4		
5	6		
7	8		
9	10		
11	12		
13	14		
15	16		
17	18		

Kademe 1

L1= +3.333 kVAr

L2= +3.333 kVAr

L3= +3.333 kVAr

Σ = +10.00 kVAr

From the first screen that opens, the 12/24 step values can be seen one by one with the "up-down" keys. While the step to be changed is selected, press the "set" key and the manual setting entry page appears on the screen:



In the example, the "set" key was pressed while Step 1 was selected. In 4 steps, the type, connection, voltage and power of Step 1 are entered. The steps to be entered manually must be entered one by one in this way.

Instead of entering the steps manually, we recommend using the relay's advanced step learning feature. In particular, there is a risk of wrongly entering the phases of single-phase capacitors manually. There is no such risk with automatic learning.

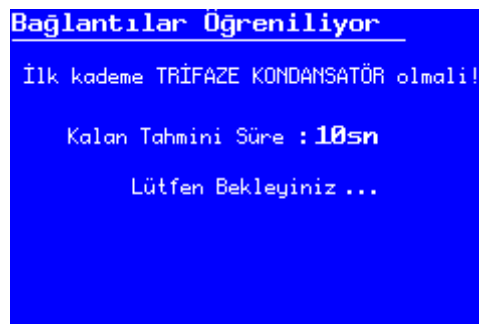
Connection Settings:



"Connection Settings" is selected from the main menu and this menu is entered with the "set" key. In this menu, the current transformer ratio and voltage transformer ratio are set. If desired, only the connection test can also be performed.

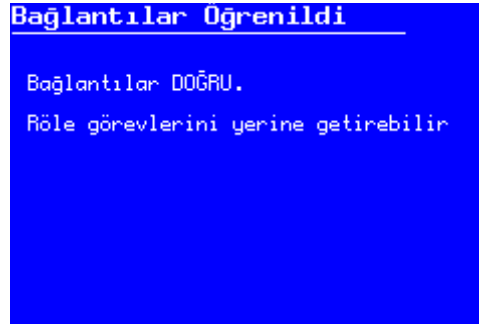
For the current transformer ratio, for example for 600/5, 120 is entered. If it is desired to use a voltage transformer ratio, it is set in "0.1" steps. Voltage Transformer Ratio = primary voltage / secondary voltage. In 230V LV installations, "1.0" must be entered.

Connection Test: At step 3, "YES" is selected and the "set" key is pressed. The relay starts testing the connections. The connection test and the step test are separate tests. Both are performed one after the other only in the "Quick Setup Wizard". In the connection test menu, only the connection test is performed. In the "learn steps" menu in the step settings, only the step test is performed. The necessary information appears on the screen while the connections are being tested:

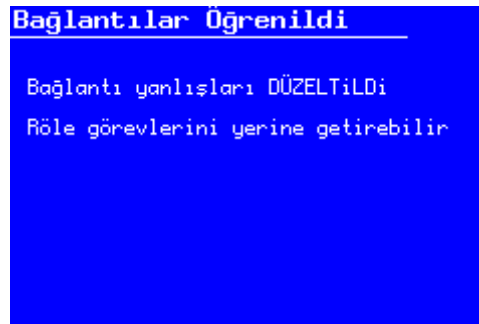


The connections are learned by switching the first step in and out. If an error occurs during the connections, a warning is given. If the connections are correct or have been corrected automatically, the following messages are given:

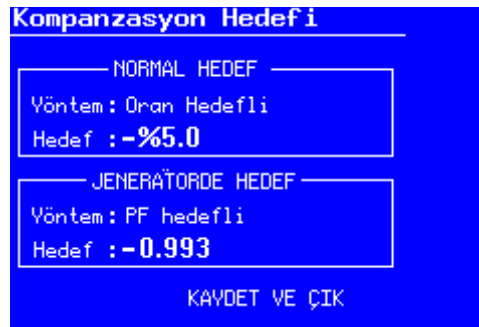
If the connections are already correct:



If the connections have been corrected:



Compensation Target:



"Compensation Target" is selected from the main menu and this menu is entered with the "set" key.

In this menu, the normal operating target and the generator operating target are set. If a generator is not used, the generator target can also be used as a second target that operates when the relay's digital input is active for another purpose.

In the Power series, 2 separate targets can be set in 3 different ways each. In this way, the system is kept in the desired reactive region, at the desired reactive percentage, or at the desired power factor. The relay makes all its interventions to achieve the entered target.

When the generator is running, operation at a different target can be selected. This feature can also be stretched for other purposes by activating the digital input.

The default target is "0%" reactive ratio. If you need to operate your system in the capacitive or inductive region, it is enough to set the target. The Power relay takes care of the rest. If there is a need

for capacitors or reactors to achieve the target, it tells you the required steps in the recommendations menu, without you needing to analyze. See: "Recommendations menu".

Target settings are made in 5 steps.

1. Normal target method: Can be selected as Ratio Target, PF (power factor target) or transformer loss target.

2. Normal target: If the ratio target method has been entered, the inductive or capacitive target is entered as a percentage, in steps of one thousandth.

If the PF target method has been entered, the target PF is entered as inductive or capacitive.

If the transformer loss method has been selected, the transformer loss power is entered as a kVAr value, and the relay achieves the target by switching in a fixed capacitor of this power.

3. Generator target method: Entered like the normal target method. The difference is that this method applies when the digital input is active.

4. Generator target: Entered like the normal target.

Alarm Settings:



"Alarm Settings" is selected from the main menu and this menu is entered with the "set" key. Press the "esc" key to exit.

In this menu, all alarm settings can be seen and made. The alarm settings are completed with 9 alarm settings and the save operation at the 10th step. "esc" can be used to return to the previous line. "set" moves to the next line, and while on the "SAVE AND EXIT" line, pressing the "set" key saves the alarm settings.

1. Contact Function: HORN or FAN is selected. If HORN is selected, the alarm contact pulls in on all alarms and sounds the connected horn. If FAN is selected, it is effective only on the temperature alarm; the contact pulls in at excessive temperatures, runs the connected FAN and lowers the temperature inside the panel.

2. Temperature Limit: The temperature value at which the excessive temperature alarm is given and, if necessary, the fan is run. The default is 55 degrees and can be adjusted as needed.

3. Capacitive Penalty Alarm: If, for any reason, the relay has not been able to bring the capacitive values below this set percentage, a capacitive penalty alarm is given. This value is 15% by default. It can be adjusted in 1% steps. This alarm is given if the last hourly percentage is excessively capacitive and the new hourly percentage is also excessively capacitive. If you receive this alarm often and the daily and weekly percentages are running at the capacitive limits, your panel needs reactors. Thanks to the Power relay, you do not need to calculate and analyze this need yourself. You can see the values your system needs in the recommendations menu.

4. Inductive Penalty Alarm: If the inductive ratio percentage runs high, an alarm is given above this setting. If you receive this alarm often and the daily and weekly inductive energy ratios are running high, your system needs capacitor steps. Or your loads are very fast and you need a TCR or thyristor or hybrid relay. For step needs, you can look at the recommendations menu.

5. Overvoltage Alarm: The value at which the device gives an alarm when the network voltage rises. When this alarm occurs, the steps are put into protection. All steps in circuit are switched out. For this reason, it should not be set unnecessarily low. The default value is 260V.

6. Undervoltage Alarm: This alarm is given when the network voltage falls below a certain voltage.

7. Overcurrent Alarm: This alarm is given when excessive current is drawn. The default value is 6A x current transformer ratio. For example, for a 600/5 current transformer, in a panel with a ratio of 120, this value is 720A.

8. Voltage Harmonic Alarm: When the total harmonic distortion in any phase voltage exceeds the limit value set here for 10 s, the "Excessive THD-U" alarm is given.

9. Current Harmonic Alarm: When the total harmonic distortion in any phase current exceeds the limit value set here for 10 s, the "Excessive THD-I" alarm is given.

When the excessive temperature and overvoltage alarms occur, the relay protects the steps by switching all steps out of service. For this reason, these alarm limits should not be set unnecessarily low.

Power relays have a built-in buzzer as standard. In most panels where no horn is connected, the buzzer sound at the moment the alarm occurs will be sufficient. However, if the distance is very long, we recommend installing a horn.

Recommendations:

Tavsiyeler (günlük)		
5.00kVAr	trifaze kondansatör	%6.2
1.50kVAr	trifaze kondansatör	%4.5
0.50kVAr	L1 kondansatör	%2.3
1.00kVAr	L3 reaktör	%0.7

In the example screen, daily recommendations are seen. The Power relay monitored and analyzed the power flow of the previous day and calculated that 4 step applications would reduce the reactive energy ratios by 6.2%, 4.5%, 2.3% and 0.7%. And it shows this to the user easily. For example, if the user follows this recommendation and connects a 5kVAr three-phase capacitor to an empty step, the reactive ratio decreases by a further 6.2%. In the example there is also a reactor recommendation for phase L3. This recommendation can be applied to reduce the capacitive ratio by 0.7%. For installations that are safe even without the 0.7% reduction, this recommendation is disregarded.

While in the main menu, the recommendations menu is entered by selecting the "Recommendations" item and pressing the "set" key. The Power-15 SVC produces recommendations according to an analysis with two time periods, hourly and daily. When the menu is first entered, the daily recommendations appear on the screen. If there is no recommendation, only the title appears on the screen. By pressing the "set" key, you can switch to the hourly recommendations screen. Switching between hourly and daily recommendations is done with the "set" key. The daily recommendations are calculated and produced by the relay according to the analysis of the last 24 hours when passing to the new day at 23:59:59. If the relay is not energized at that time, these calculations are left to the next day's changeover. By setting the clock to 23:59, the relay can be made to produce forced recommendations without waiting for the end of the day. In this case, the recommendations are not based on 24 hours but on the power flow over however much time has passed since the last daily changeover. This method can be applied in urgent situations. Or the hourly recommendations

can be consulted.

Hourly recommendations are exactly like daily recommendations. The difference is that they are calculated not when passing to the new day at 23:59 but every hour according to the power flow of the last hour.

The recommendations of the Power relay are effective and reliable. It recommends single-phase and three-phase capacitors and reactors, and also shows how much the recommendation will reduce the reactive energy ratios.

When there is a change in the load conditions of the system, you can see the new step needs from the daily recommendations or, without waiting long, from the hourly recommendations.

Generally, when the system is first commissioned, it is not exactly known what steps it will need. In such cases, you can connect a few three-phase capacitors and apply the daily recommendations the next day. The relay can make recommendations for 10 steps at once, in order of importance, also showing their percentage effect.

The relay does not even display step recommendations that would be less effective than five thousandths (0.5%) on the reactive ratios.

In places running above and near the penalty limits, we recommend applying at least the priority recommendations. If you are below the penalty limits, applying the recommendations helps you get even closer to your desired compensation target.

Other Settings:

When the "Other Settings" menu is selected from the main menu and the "set" key is pressed, the device moves to the other settings screen:

```

Diğer Ayarlar
Baud.....:128000
Parite.....:ÇİFT
Adres .....:1
Şifre Değiştir.:HAVIR
Tarih Saat....:AYARLI
Dil/Language...:Türkçe
Buzzer.....:Açık
Fatura kesim ..:5
TCR fonksiyonu.:her zaman aktif
KAYDET VE ÇIK

```

The relay's rarely needed settings, which are separate from the other categories, are gathered in this menu.

Baud: The communication speed setting in models with communication. It can be set to 1200, 2400, 4800, 9600, 19200, 38400, 57600, 115200, 128000, 256000.

Parity: For communication; none, odd or even can be selected.

Address: 247 different devices can be connected to a Modbus RTU RS-485 line. The Modbus ID that distinguishes these devices from each other can be assigned between 1-247 with this address setting.

Change Password: While "No" is selected, if the "set" key is pressed, it moves to the next setting line without changing the password. If "Yes" is selected and the "set" key is pressed, the password change window opens at the side:



The password is changed in two stages. First the 4 digits of the new password are entered one by one. Then it is repeated to prevent possible mistakes. After it is changed, "changed" appears under the window and the next setting continues.

The device's factory password is "0000". Users who change the password must not forget it. Otherwise, they will need to contact our company to enter the menu again.

Date Time: To change the date and time settings, "Update" must be selected and the "set" key pressed. If already set, "Set" must be selected and the "set" key pressed. If "Update" is selected, the date-time setting window opens at the side of the screen:



In this window, the "day", "month", "year", "hour", "minute" and "second" information is selected in order and saved with the "set" key. In case of a wrong step, it is possible to go to the previous step with the "esc" key. For all menus, "set" works as forward and "esc" as back. When the clock and calendar information is entered, "Updated" appears under the window and it moves on to the next setting.

Language: The relay's language can be selected here as English or Turkish.

Buzzer: Power relays have a built-in buzzer, and while navigating the menu with the keys and in alarm situations, the buzzer gives the necessary sounds. If desired, it can be turned off and on from this menu. If it is turned off and there is also no horn on the contact output, alarm situations will not be heard. For this reason, we recommend leaving it on.

Billing cut-off: Selects the day of the month on which monthly energy ratios are calculated.

TCR function: 6 different SVC/TCR modes are selected from this menu. These settings are explained in detail in the SVC section.

Manual Test:

When the "Manual Test" menu is selected from the main menu and the "set" key is pressed, the device switches to manual test mode. In this mode, the relay does not intervene in the steps. Only the user intervenes in the steps by turning the steps "on" and "off" one by one. Manual test mode is for testing by manually switching steps in and out. Even if the relay is forgotten in this menu, it returns to normal mode by itself after 5 minutes. Since compensation stops during the time spent in this menu, the reactive meters register.

MANUEL TEST	
K- 1: ON	K-10: ON
K- 2: ON	K-11: ON
K- 3: ON	K-12: ON
K- 4: ON	R-1 : 3000
K- 5: ON	R-2 : 3000
K- 6: ON	R-3 : 3000
K- 7: ON	
K- 8: ON	
K- 9: ON	

While in the manual test menu, the currently selected step is in the "off", "on" or "discharging" state. Pressing the "set" key while it is "on" switches the step to "off". Pressing the "set" key while it is "off" switches the step to "on". A step in the "discharging" state cannot be switched "on" until the discharge time has elapsed.

The "on" state means the step is switched in, and the "off" state means the step is switched out.

With R1, R2, R3, the trigger output angle for the reactor driver module is adjusted and tested. Each reactor is divided into 3125 steps.

Event Log:

"Event Log" is selected from the menu and this screen opens by pressing the "set" key:

Olay Kaydı	
23.01.2013 10:30:01	Kalibrasyon
31.01.2013 15:43:54	Son bağlantı testi
31.01.2013 15:45:20	Son Kademe testi
01.02.2013 05:42:26	Cihaz açıldı
01.02.2013 05:42:22	Aşırı gerilim L1L2L3
01.02.2013 05:46:26	Düşük gerilim L1L2L3
02.02.2013 22:42:26	Aşırı akım L1L2L3
02.02.2013 02:45:20	Aşırı THD-U L1L2L3
02.02.2013 06:23:26	Aşırı THD-I L1
02.02.2013 11:03:15	Aşırı sıcaklık
03.02.2013 15:32:57	Endüktif Ceza
03.02.2013 09:00:44	Kapasitif Ceza
13.02.2013 20:25:27	Aşırı gerilim L1 L3

In the Power relay, it is possible to see important past events and the alarms that have occurred together with their date and time. 13 events are kept: 3 fixed events and 10 events where the oldest is deleted as new ones arrive. The 3 fixed events show the date the device was calibrated, the last connection test and when the last step test was performed. The other 10 events show the times and states when the device was energized and alarms occurred.

Reset Menu:

Sıfırlama Menüsü
Enerjileri Sıfırla
Demanları Sıfırla
Fabrika Ayarlarına Dön
Kademe sayaçlarını sıfırla

While in the main menu, the "Reset menu" item is selected and this menu is entered by pressing the "set" key.

There are four items in this menu. The desired command is selected with the "up-down" keys and applied with the "set" key. The relay asks for confirmation. Pressing the "set" key again gives confirmation, and the operation is applied. In order to analyze the monthly, weekly and daily ratios properly, it is a better habit to reset energies at the beginning rather than deleting them continuously. After returning to factory settings, you must not forget to make the new settings. It is also not recommended to delete the step counters unless the relay has been moved to a new panel. For retrospective analysis, not deleting these values and deleting them only at the beginning is a good usage habit.

6. Default Settings

The default values of the settings and the setting descriptions are as in the table:

Setting:

Description

Default

Current Transformer Ratio

From 1 to 2000
in steps of 1

1

Voltage Transformer Ratio

From 1.0 to 5000.0
in steps of 0.1

1.0

Password

4 digits

"0000"

Dil/Language

Turkish or English

Turkish

Step Values

Step powers are entered automatically or manually

0

Step Counters

Step counters show the number of switchings and the time in circuit of the step, in terms of step life.

0

Demand Period

5 min-60 min in 5 min steps

15 min

Step Count

3-18

18

Buzzer

On or off. It must not be turned off for the buzzer to sound on alarms.

on

Billing Cut-off Date

Selected as end of month or between 1-31. Selecting 28, 29, 30 or 31 is no different from selecting end of month. Energies are reset on the last day of the current month. Or energies are reset on the set calendar day.

End of month

Step Switch-in Time

Automatic or 1 s-100 s in 0.1 s steps

auto

Step Switch-out Time

Automatic or 1 s-100 s in 0.1 s steps
auto

Discharge Time

Automatic or 1 s-500 s in 1 s steps
auto

Reactor Switch-in Time

Automatic or 1 s-500 s in 0.1 s steps
auto

Reactor Switch-out Time

Automatic or 1 s-500 s in 0.1 s steps
auto

Periodic Learning

Off, daily, weekly can be selected.
daily

Periodic Learning Time

0-23 can be selected.

01:00

Normal Compensation Target Method

Ratio-PF-transformer loss
Ratio

Normal Compensation Target Value

10% cap, 0%, 10% ind
In steps of 0.1%
0%

Generator Compensation Target Method

Ratio-PF-transformer loss
Ratio

Generator Compensation Target Value

10% cap, 0%, 10% ind
In steps of 0.1%
0%

Alarm contact function

Horn or fan
Horn

Temperature Alarm

Can be used to run a fan. At excessive temperature the steps are put into protection, so it must be set carefully.
55 degrees

Overvoltage Alarm

At high voltage, together with the alarm, the steps are switched out for protection
255V

Undervoltage Alarm

At low voltage only an alarm is given
175V

Overcurrent Alarm

For an overcurrent alarm, it must not be set below the nominal current
6A x (current transformer ratio)

Overvoltage-THD Alarm

Alarm at excessive voltage harmonics, can be set in 1% steps
15%

Overcurrent-THD Alarm

Alarm at excessive current harmonics, can be set in 1% steps
60%

Inductive Penalty Alarm

Used only as an alarm limit
20%

Capacitive Penalty Alarm

Used only as an alarm limit
15%

Baud

4800,9600,19200,38400,
57600,115200,128000,256000
115200

Parity

None, odd, even

none

Address

Between 1-247

1

TCR function

Off

Synchronous active

Asynchronous active

Independent of P(kW)

Only on capacitive load

Active if near penalty

Synchronous active

Users who want to change the password must not forget it in order to enter the menu again. Those who forget the password need to contact our company.

It is recommended to use automatic step switch-in/out times.

Since the settings are fundamentals affecting the whole system, settings should be changed by authorized persons, and password protection should be used if necessary.

7. Practical Information

Power-15SVC relays are designed so that their users can manage compensation in the fastest and easiest way.

At first commissioning, the connections are made, checked and the relay is energized. To set up the relay, if the device has just left the factory, it is easily commissioned in 3 steps with the "quick setup wizard" menu. If it is a relay that has been used elsewhere, first return to factory settings from the "reset menu", then easily commission it in 3 steps with the "quick setup wizard" menu.

Although the use of the menu is explained in detail in the menu section, it is easily done with four keys.

The "set" key is used to enter menus, confirm, advance and save. To enter the menu, the "set" key must be pressed for a long time. A long press means pressing for 3-5 seconds without releasing.

The "esc" key is used to return to the previous menu or setting, go back, exit, or cancel without confirming. Pressing this key for a long time resets the menu and screen. To return to the main screen from all menus and measurement screens, a long press of "esc" is sufficient.

The "up-down" keys are used to increase and decrease, to move between values in list values, and to move between screens on the measurement screens.

In summary, menu use: enter with "set", select with "up-down", confirm with "set" and move to the next item; do the same in the next one and save with "set".

For analysis using the measurement screens, use the "up-down" keys while on the main screen or any measurement screen. There are also navigation icons on the right of the screen for moving between the I-U-UU-P-Q-S-E-%E-GEN E-TARIFF E-HARMONICS pages. For details, see the measurement screens section.

After the step count and current transformer ratio have been entered in the relay from the "quick setup wizard" menu, the relay automatically corrects connection errors and reports errors that cannot be corrected. Then, by switching the steps in and out in order, it learns all the steps. This may take a few minutes under load, and if there are steps it could not learn within 10 minutes, these steps are completed manually or the relay completes the missing ones at the periodic learning time. The "Step Settings" menu is used to enter steps manually. The "Step Settings" menu is also used to select the periodic learning period and time.

If special discharge resistors or discharge coils are not used, the values given by the capacitor manufacturer must be entered for the discharge time. If there are discharge coils/resistors, the discharge time should be left on automatic.

Leaving the step switch-in/out times on automatic will be healthy for the "compensation / system life" balance. The carefully prepared automatic intervention time algorithms and smart intervention algorithms of the Power relay are very successful.

After introducing the connections and steps and reviewing the step settings, other settings can be made. For example, if there are special preferences for alarms, the desired settings are made from the "Alarm Settings" menu. Operations such as date-time setting, password change, buzzer on-off, and billing cut-off day (if known) setting are done from the "Other Settings" menu.

If you do not yet know the loads of the system in which the relay is installed, the relay's "Recommendations" menu will save you time and effort and, by analyzing the system's reactive power flow, will recommend the necessary capacitors and reactors. The recommendations feature is advanced enough to also tell how much each recommendation will reduce the energy ratios.

From the "Event Log" menu, you can look at important past events and follow what happened while you were away.

When the connections of the Power relay are first made or changed, the "connection test" must be performed. The connection test is essential for the measurements, and therefore compensation, to work reliably. To perform the connection test on its own, the "Connection Settings" menu is used.

It may be desired that the compensated installation operate in the capacitive or inductive region. The relay's factory default target value is a 0% reactive ratio. If the compensation target setting is not changed, the relay tries to pull the reactive ratios to zero, and therefore the power factor and cosφ values to 1.000. It switches the steps accordingly. If the setting is changed, the relay works to achieve the entered reactive percentage or power factor. The entered targets can be capacitive or inductive. For example, if the system is near the end of the month and in penalty on inductive, and the capacitive ratios are far from penalty, penalty can be avoided by selecting the target value as capacitive. The following may cause this situation: the relay has just been connected, or the steps are insufficient, or there has been a failure in the steps. In the end such negative situations are encountered, and target setting can be applied as a solution for these situations in the Power relay.

Target settings can also be used for different purposes. For example, if pulling reactive powers to zero causes resonance and harmonics between some loads, target values can be set to ratios such as 3%, 5%. If a different power factor is wanted on the generator, a separate target setting for the generator and a digital input on the relay to activate it are available.

After the relay is commissioned, it must not be left without performing the connection test. Then the step test must be performed. After the step test, the steps must be checked from the "step monitor" screen. As a precaution, the phase active powers can be checked on the active powers page. No phase active power value should have a minus sign in front of it. The correct operation of the system depends on the relay knowing the connections and steps correctly. In addition, especially the temperature alarm, overvoltage alarm and compensation target settings must be entered correctly. In temperature and overvoltage alarms, the relay switches steps out to protect them.

The connection test and step test can be performed together from the "Quick setup wizard" menu. For the connection test only, the "Connection settings" menu is used. For the step test only, the "Step settings" menu is used. Steps can also be entered manually. Entering all steps manually is not recommended. The step learning test is run again automatically by the relay at the periodic learning time. It is recommended not to turn off the periodic learning feature and to set it to hours when the load is low. Especially since the load is low at night in most businesses, it can be set to night hours. Or it can be set to noon hours. In summary:

1. Make the relay connections according to the rules and energize the relay.
2. Make sure that the first step has a three-phase capacitor, and if the relay has been used elsewhere before, give the "return to factory settings" command from the "Reset menu".
3. After seeing that current and voltages are present on all 3 phases, enter the "Quick Setup Wizard" menu. If there is no load, switch in a three-phase capacitor manually and see that current flows in all three phases.
4. In the "Quick Setup Wizard" menu, select the step count and current transformer ratio, and give the learn connections and steps command.
5. When it says connections are correct or corrected, continue with the step test using the "set" key. Or after a few seconds the relay will start learning the steps by itself.
6. While the steps are being learned and after they are learned, the necessary information will appear on the screen. When finished, exit with the "esc" key. The relay will start compensation.
7. If there are special settings you want to change, change them by entering the relevant settings page from the main menu.

If anything goes wrong during these steps, the relay will give the necessary warning. Then make the correction and start again from the beginning.

Using the SVC:

The Power-15 SVC relay can be used just like a classic contactor relay. It has 3 trigger outputs for SVC. A reactor driver module is connected to these trigger outputs. 3 reactors are connected to the reactor driver module. In this way, nearly 10 thousand steps are obtained.

The Power-15 SVC relay and the Power thyristor reactor driver modules work in harmony, extremely stably. Their life is incomparably longer than contactor steps.

What is the Power-15 SVC?

It is the compensation relay, called an SVC or TCR system, that the Power relay family developed for the most complex and fast installations. Compared with other SVC relays, it has far superior usage, analyzer and intervention features. For the SVC function, it offers a unique experience with 6 different modes, not 1.

By dividing the reactors into approximately ten thousand steps, it performs effective compensation as if there were thousands of capacitors and reactors in the system. It has contact outputs for up to 12 steps and 3 semiconductor trigger outputs, with one reactor connected to each phase. It can be used just as a classic relay, or as an SVC relay with 1 reactor driver and 3 reactors.

What are the benefits of the Power-15 SVC?

It provides economical, long-life and smart intervention modes even in a mixture of every situation: balanced-unbalanced, fast load-slow load, low power-high power.

1. It ensures definite compensation success even in the most troublesome facilities.
2. With only 3 reactors, it meets the needs of thousands of single-phase capacitors and reactors. It reduces cost.
3. Semiconductors are fast, silent and long-lived. They also reduce long-term maintenance costs.
4. It handles unbalanced loads perfectly and precisely.
5. It compensates fast loads quickly at system frequency (up to 50 times per second - 20 ms speed).
6. At the same time, it achieves flawless results with both very low-power loads and high-power loads.
7. Both capacitors and reactors can be connected to the normal steps.
8. It solves various problems with 6 different TCR modes.
9. With the manual test, it offers the possibility to test each step of the TCR steps one by one.
10. On the main screen there is a bar graph showing to what extent the TCR steps are in circuit, and power status information showing how many kVAR of reactor they add.

11. The SVC steps are also learned automatically by the relay.

What are the TCR/SVC function modes of the Power-15 SVC relay?

They allow you to set how and when the SVC intervention will be performed.

The SVC system has 2 disadvantages: a small amount of active power consumption, and the generation of harmonic currents. In the Power relay there are measures and settings that ensure SVC intervention is made only when necessary, to protect against these disadvantages. With these features, found only in the Power relay, you use the solution best suited to your system in the way that affects the power quality of the system the least.

In brief, these modes are:

1. off: The SVC function never comes into operation. It is used to turn off the SVC function. For example, if the SVC relay was chosen with the future in mind and only the classic outputs are used, off can be selected.

2. synchronous active: The SVC function is continuously in operation. There is no relay within the relay in this mode. Intervention on the normal steps and intervention on the SVC steps are carried out synchronously to achieve the desired compensation target.

In this mode the relay adjusts both capacitors and reactors together.

3. Asynchronous active: The SVC function is continuously in operation. In this mode, the SVC steps compensate the reactive power left over from the intervention on the normal steps. It works differently from the synchronous mode. In asynchronous mode the reactors come into operation less than in synchronous mode.

4. Independent of P(kW): In this mode, the SVC function works synchronously, purely to meet reactive powers, even when there is no active power at all. The difference from the synchronous and asynchronous modes is that it works without requiring a certain active power threshold. It can be preferred in this mode to meet loads with an 85 degree phase angle even when there is no other active load.

5. Only on capacitive load: In this mode, the SVC function does not work while a capacitor is in circuit. When no capacitor is in circuit and the load is capacitive, the SVC function works. The purpose in this mode is only to compensate capacitive loads with the SVC. Other loads are compensated with the normal steps.

6. Active if near penalty: In this mode the SVC function does not always come into operation. As soon as the hourly ratios approach the penalty limits, only in the hours and minutes when the penalty is approached or exceeded, the SVC comes into operation and prevents reactive energies from accumulating. In this way, since it is put into operation only when needed, you are protected from the harmonics it produces and the small amount of active power it consumes.

Power-15 SVC

Commissioning the Relay

!!! Before starting the connections, always cut the power; never make connection changes while electrical power is on. !!!

a. Relay Voltage Connections

- a.i. Connect the 3 phases of the network one by one to the relay's L1-L2-L3 voltage inputs. Even if the phase direction and order are connected wrongly, the relay will correct it.
- a.ii. Make the neutral connection to the relay's neutral input; never connect a phase instead of neutral. Connecting a phase to neutral causes damage to the system.
- a.iii. When making voltage connections, take utmost care that terminals are not loose and do not short-circuit with other terminals. Otherwise, serious damage will occur in the system.

b. SVC Driver Module Voltage Connections

- b.i. Connect the 3 phases of the network to the L1-L2-L3 voltage inputs of the SVC driver module in the same order in which you connected them to the relay's voltage inputs. Whichever phase you connected to the relay's L1 voltage input, connect the same phase to the driver module's L1 voltage input. Whichever phase you connected to the relay's L2 voltage input, connect the same phase to the driver module's L2 voltage input. Whichever phase you connected to the relay's L3 voltage input, connect the same phase to the driver module's L3 voltage input.
- b.ii. When all connections are finished and you energize the system for the first time, you can check that the phases are not different by measuring the relay voltage inputs and the driver module voltage inputs one by one with a multimeter/voltmeter.
- b.iii. The voltage between the relay's L1 voltage input and the driver module's L1 input must be zero; if it is connected wrongly, there will be phase-to-phase voltage between them since they would be different phases. For example, for 230VAC systems, if a voltage between 380-400V is seen, this means the driver module is connected wrongly. Likewise, there must be no voltage difference between the L2 inputs of the relay and the driver module, nor between the L3 inputs of the relay and the driver module. If there is phase-to-phase voltage, it is wrong and must be corrected manually.

- b.iv. If the voltage inputs of the driver module and the relay are accidentally connected to different phases, during the step learning stage the relay will see the reactor values as considerably lower than they are. For example, it may see a 5kVAr reactor as 2kVAr. It also works making a clicking sound and causes very high harmonics.
- b.v. When making voltage connections, ensure terminals are tight and do not short with other are not loose and do not short-circuit with other terminals. Otherwise, serious damage will occur in the system.

Relay current connections;

- b.vi. Connect the pairs coming from the current transformer to the relay's L1-L2-L3 current input pairs in order. As long as the k-l terminals of the pairs are not crossed with each other, the relay will automatically correct other connection errors. For example, if you connect the "k" terminal coming from L1 and the "l" terminal coming from L2 to the relay's L1 current input pair, the relay cannot correct this crossing. As long as you do not make such crossings, the relay will automatically correct other phase crossings and polarity errors.
- b.vii. When making the relay current connections, take utmost care that the terminals are tightened firmly and are not loose. Leaving current terminals open-circuit causes fatal damage to the system.

Reactor connections of the SVC driver module;

- b.viii. Connect one end of each reactor to the L1-L2-L3 outputs of the driver module. Join the other ends of the reactors and connect them to neutral. If the reactor is a star-connected three-phase reactor, connect the star point to neutral and the other pins to the L1-L2-L3 outputs in any order.
- b.ix. When making the connections, take utmost care that terminals are tightened firmly and that there is no open/short circuit.

R1-R2-R3 trigger connections of the TCR driver module;

- b.x. Run connections correctly, in order and without crossing, from the relay's R1 port to the driver module's R1 port, from the relay's R2 port to the driver module's R2 port, and from the relay's R3 port to the driver module's R3 port. The voltage at these ports is 5VDC.
- b.xi. Connect the relay's "+" port to the driver module's "+" port.

Connecting the steps to the relay's contact outputs;

- b.xii. Connect the classic contactor steps, from 3 to 12, as many as you need.

- b.xiii. Connect a three-phase capacitor to the first step, and if possible the step of the largest power. This is required once for the connection test to be performed reliably. After the relay has been set up, it is not important if this step is changed.
- b.xiv. You can connect either reactors or capacitors, three-phase or single-phase, to the classic steps without distinction.
- b.xv. In the TCR relay, reactors are generally not used on the classic steps for small reactor needs. Each of the reactors connected to the R1-R2-R3 outputs already behaves like thousands of reactors by being divided into 3125 steps. However, in some installations a large-power reactor may be needed in addition. A solution for these installations can be produced by connecting reactors to the classic steps.

Energizing the relay, driver module and system;

- c. After making sure that you have made the connections properly and securely, energize.
 - d. Check the relay L1-L2-L3 voltage inputs and the driver module L1-L2-L3 voltage inputs with a voltmeter as described in 1.b.
- e. On the relay's main screen, at the bottom right, check that the voltage of the 3 phases is correct. If there are phases without voltage, find them and correct them.
- f. If there is no load in circuit, it is useful to manually switch in any three-phase load or step and see on the main screen at the bottom right that current flows in all 3 phases. If you cannot do this, in the automatic connection test the relay will warn about the phases with no current if there is none. If there is, find the phase/phases with no current, correct them and continue.
- g. If the connections are complete and voltages and currents are present, carry out the following tests with the relay's menu in the next steps.

Performing the connection test with the relay's "Quick Setup Wizard" menu;

- h. Hold the relay "set" key pressed for 3-5 s. The password screen will appear.
- i. Enter the password. The default is "0000".
- j. The main menu will appear on the screen. Enter the "Quick Setup Wizard" menu.
 - k. Enter the step count. Enter the number of classic steps.
 - l. Enter the current transformer ratio. For example, enter 20 for 100/5.
 - m. Press "LEARN>" for "connections and steps" with the "set" key to make the relay start learning the connections.

- n. The relay will switch the first step in and out and find and correct polarity and phase crossing errors at the current inputs. If there are loads operating in the system, the relay will keep trying until it is sure.
- o. When the relay says "I corrected the connection errors" and "connections are correct", it will move on to the step test. If there is a mistake in the connections, correct the errors according to the relay's relevant message and try again.
- p. After the connection test has passed successfully, the relay will switch the steps in and out in order and learn all steps, including the SVC steps. Check that the SVC steps are learned correctly taking into account the reactor power you connected. During the step test, the status of all steps can be seen together on the screen.
- q. When the connections and steps have been learned, the relay can start compensation.
- r. If you are going to make special settings, you can examine the other menus.

BOX DIMENSIONS;

