KAEL

DYNAMIC COMPENSATION

SUPER - SVC

ULTRA fast,
Bidirectional Reactive power Stabilizer

ALARMS

if there is a faulty connection at the capacitor or reactor outputs SUPER-SVC closes output.

If the capacitor or reactor cable comes out while the device is operating,,corresponding output is closed.

If a capacitor or reactor with high power value is mistakenly connected to the output, it sences overcurrent and closes corresponding output

When overvoltage occurs, the device deactivates the capacitors

It warns the user when the current transformer is connected incorrectly.

If the chosen power of the reactor or capacitor is low, the device will give a warning. (under compensation)

- Plug and Run
- Unique and ideal design
- Ultra Fast
- User Friendly
- Low Cost
- Bidirectional Compensation
- Automatic Learning of Reactor and Capacitor Power
- Automatic learning of current directions
- 5 - 20 ms response time
- Enough for low-power facilities
- Provides the most economical solution by connecting in parallel to the system

- **Single module - Three phase connection :** In facilities between 9 KW and 30 kW, device installation cost is much lower than in other systems.
  Single module - Single phase connection : In facilities between 30 KW and 70 kW, device installation cost is much lower than in other systems.
- Low-power facilities can comprise banks, bakery, markets, fast food stores, workshop in small industrial zone, hotels, school, fuel station, base stations, textile workshop, monastery, church, state institutions.
  The mechanical noise generated by the contactors used in classical reactive power compensation systems is uncomfortable and disturbing.
- As both capacitor and reactor are thyristor-controlled, it responds rapidly in both directions (inductive and capacitive).
- The first commissioning of the SUPER-SVC is very easy. With dip-switch, it is sufficient to determine the current transformer ratio in the system. No other settings are required.
- The SUPER-SVC can be connected to the system in parallel with power factor controller.
- Due to fast response, it extends the working life of PFC output contacts and contactors in the system.
- Also the SVC unit can be connected to the welding and spot welding machines in parallel.
  (For local compensation)
- It can also operate in TCR mode.

Warnings

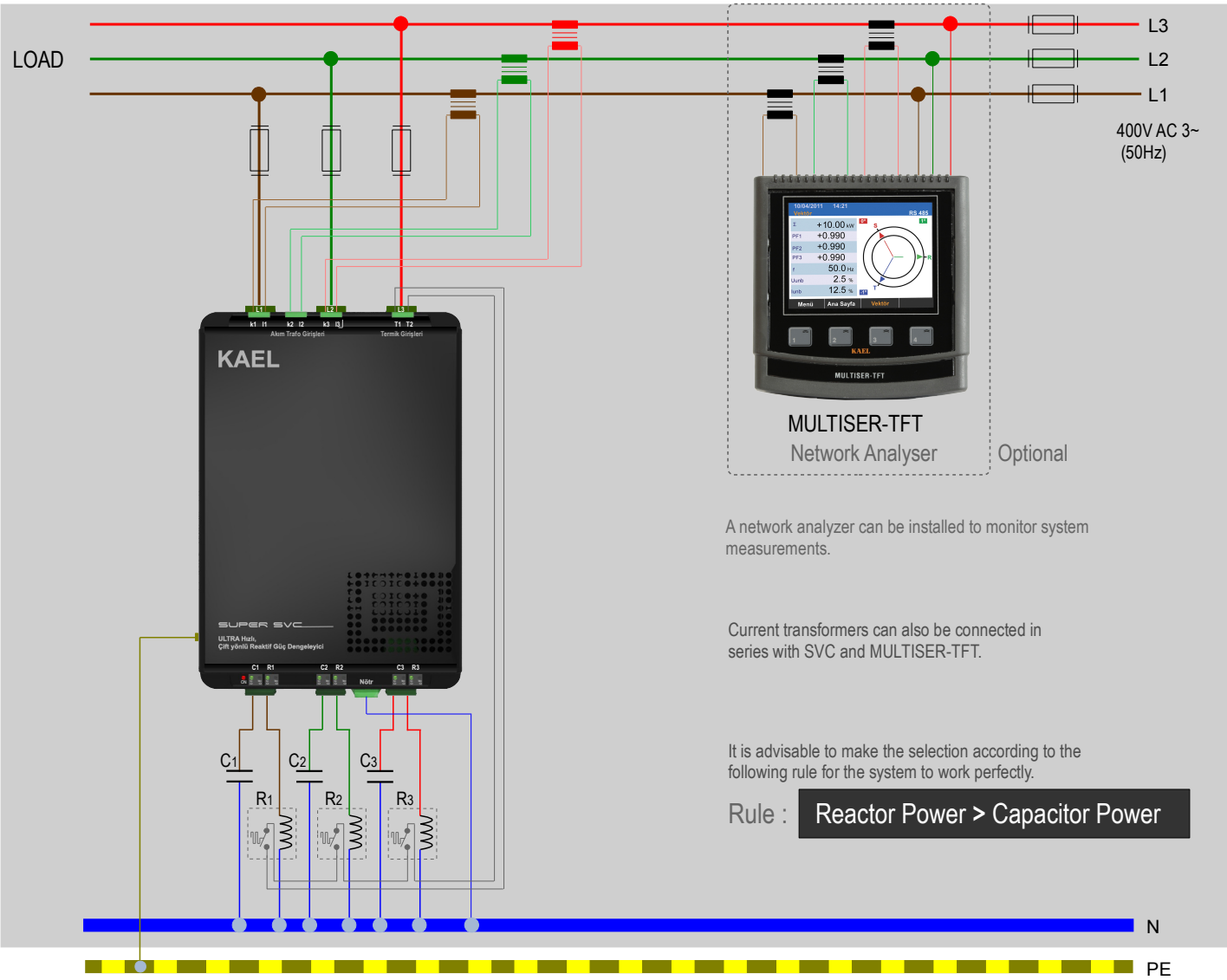
1- SUPER-SVC is a device based on the latest technology and has very fast semiconductors. Therefore, connections should be made and operated and checked by authorized and expert persons.
2- Since the compensation is a complex system, it is recommended to keep the system under constant control by electrical engineers and technicians.
3- Do not open device enclosure . There are no user-serviceable parts inside the device.
4- Before making electrical connections to the device terminals, make sure that there is no energy in the cables and terminals. There should not be any energy in the electric panel.
5- Do not use the device for different purposes other than the system compensation.
6- For ideal heat transfer fix the device vertically firmly on the mounting plate in the panel.
7- **Install a sufficient number of fans on the panel to cool the device and reactors.**
8- Clean the appliance with a dry cloth after making sure that you have cut off the energy of the panel. Water and cleaning chemicals damage the device.
9- Before supplying power to the device, make sure that the terminal connections are made in accordance with the connection diagram and in a way not to cause contact problems (loose connection or interconnection of multiple copper wires, etc.).
10- The fuses connected to the inputs L1, L2 and L3 of the device must be selected according to the capacitor and reactor current.
11- The current transformer and voltage input must be connected to the same phase.The SUPER SVC must be connected as shown in the connection diagram. Even if the current transformer direction is reverse the device will automatically correct it.
12- The phase should not be connected to the neutral. Otherwise, the device will be damaged.
13- The value of the selected current transformers must not be less than the actual load value and must be X / 5A. It is also recommended to choose a class 0,5.
14- You must use the flat copper bar for neutral. Neutral connections of all capacitors and reactors should be made as independent to the bar with cable . Do not bridge the neutrals with each other.
15- Capacitors and reactors in the selection tables are produced for SUPER SVC and should not be preferred to other brands in terms of their value and qualities (eg discharge resistances are present in the capacitors, connections are made with terminals). Otherwise, the device or system may be damaged.
17- Before power is applied, the current transformer ratio should be adjusted by dip-switch on the side of the device.
18- The device charges capacitors which are not currently used in system compensation. Therefore, if it is necessary to change the capacitor, the energy of system should be cut off and to wait for at least 5 minutes for the capacitor to discharge.
19- The phase input terminal of the device has two poles. Both must be connected to the same phase with 4mm² cable.
20- If the PTC of the reactor is not connected to the inputs T1, T2, it is absolutely necessary to short-circuit these terminals. Otherwise, the fault LEDs of all outputs turned on when the unit is first energized and will stop operation. It should not be forgotten that in this case the reactor remains unprotected against heat.
21- The above precautions and warnings are for your safety. In case of non-compliance, KAEL Elektronik Ltd. or vendors are not responsible.

ALARMS

LOAD ERRORS	Connection error	If a capacitor is connected to the terminal of the reactor or the reactor is connected to the terminal of the capacitor, the fault LEDs of the corresponding outputs are constantly turned on and the device stops operating. The system should be powered off and the connection error must be corrected. Otherwise this error can damage the device.
	No Load	If the capacitor or reactor cable is disconnected while the device is running, the corresponding output fault LED will turned on and only the faulty output will stop operating. The other outputs of the device continue to operate. In this case, the system must be de-energized and the connection error must be corrected.
	Over Current	If the current value exceeds 30A at any phase, both the reactor and capacitor fault LEDs of the respective phase are constantly turned on and the unit stops operating. In this case, the energy of the system should be cut off and the reason should be found.
PHASE ERRORS	Over Voltage	If the phase-neutral voltage exceeds 255V, the outputs of that phase are disabled. In this case, the error LEDs of that phase will flash twice in the second. Outputs of phases with normal voltages continue to operate. When the voltage returns to the normal value (250V), the phase fault LEDs turned off and the outputs become active again.
	Phase Loss	If there is a missing connection at the voltage inputs or if the phase is interrupted, phase outputs are disabled. Also the fault LEDs of that phase flash twice per second. When the phase comes back, the device starts to work. If this warning is continuesly on, there can be a missing connection or an open fuse. The system should be de-energized first and the error should be corrected.
TEMPERATURE	Over Temperature	If the reactors or the device become overheated, all the operation and fault LEDs are constantly on and the device stops driving. When the reactors cool down, the device starts working again. If this happens frequently, the fans used for cooling the panel may be out of order or place of fans may have been incorrect.
COMPENSATION	UNDER COMPENSATION ind.	If the power of the selected reactor is lower than the system reactive power requirement for that phase, then the reactor fault LED flashes one time per second.
	UNDER COMPENSATION Cap.	If the power of the selected capacitor is higher than the system reactive power requirement for that phase , then the capacitor fault LED flashes one time per second.
CTR FAULT	CURRENT TRANSFORMER CONNECTION FAULT	If the current transformer and the voltage are not in the same phase, the operating and fault LEDs of that phase are continuously flashing on from left to right and right to left. The device does not start compensation as long as the connection error is not corrected. In this case, the system is de-energized and the CT connections errors should be made as right.

APPLICATION For Facilities between 9kW and 30kW

Single module - Three phase connection



Single module - Three phase connection :

It is absolutely necessary to connect three phases to the voltage inputs. Each phase is bi-directionally compensated.
The reactor and capacitor can be connected from 0,5 KVAR to 5 KVAR per phase. It allows the use large reactive power with one module instead of several modules for each power. Even if a low-power reactor is selected in the first installation, there is no need to buy another model if the reactor requirement increases in the future. Only the reactor and capacitors need to be replaced.
When the device is energized, it automatically learns the power of the capacitors and reactors connected to its outputs.
For facilities up to 30kW device can be used without power factor controller connected to the system .

If it is required, a network analyzer can be installed to monitor system measurements.

Selection Table

POWER	SUPER - SVC	REACTOR	CAPACITOR
9 - 16kW	1 piece	3 x **SR-230/3**	3 x **SPC 2-0.23/2.7**
9 - 16kW	1 piece	3 x **SR-230/5**	3 x **SPC 2-0.23/2.7**
16 – 30kW	1 piece	3 x **SR-230/5**	3 x **SPC 2-0.23/4.7**

Device can be used alone for reactive power compensation of all facilities between 9 kW and 30 kW. The sample panel and material selection table is shown above.

OPERATING

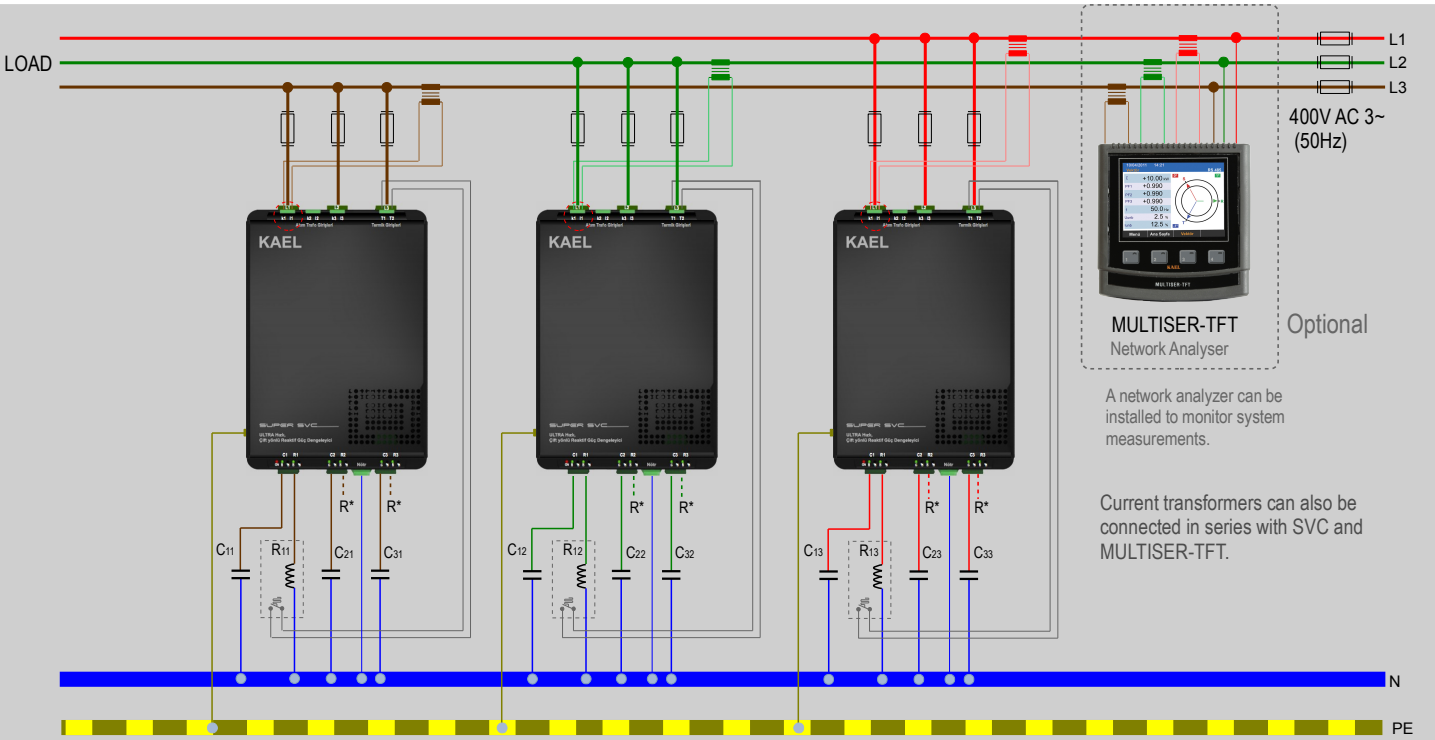
When it is energized, it firstly checks whether the three phases are connected. If there are three phases then the device finds the directions of the current transformers. Then it learns the power of the capacitors and reactors with perfect accuracy in a short period of time. Meanwhile, the operating and fault LEDs are flashing on from right to left and left to right. When learning process is completed, compensation starts immediately. After this step, the system compensation is controlled by the SUPER SVC. If there is an unconnected reactor or capacitor, it warns by turning on the corresponding fault LED.

The device response time is max 10 ms for reactors, max 20ms for capacitors. The capacitors are continuously charged even when not used. Capacitors do not have sudden current when driven. Thus, thyristors are not damaged and the capacitors have a longer life. The device can control the reactor with high resolution between 1 and 1,000 steps per 20 msec periode for 50Hz. According to measurements, SUPER-SVC reconsiders its decisions every 5ms. For this reason it has a unique speed.It provides capacitive and inductive reactive power requirements.

- SMALL MARKET
- RESTAURANT
- FAST FOOD STORE
- POLICE STATION
- THE HEALTH CLINIC
- BAKERY
- WORKSHOP IN SMALL INDUSTRIAL ZONE
- PENSION - HOTEL
- BASE STATION

APPLICATION For Facilities between 35kW and 80kW

Single module - Single phase connection



R* : If the facility requires more inductive compensation, reactors could be added to the these outputs.

Selection Table

POWER	REACTOR Requirement	CAPACITOR Requirement	SUPER - SVC	REACTORS	CAPACITORS		
				R11 , R12 , R13	C11 , C12 , C13	C21 , C22 , C23	C31 , C32 , C33
30 - 40kW	4.5 kVAR	0 – 20.1kVAR	3 pieces	3 x **SR-230/1.5**	3 x **SPC 2-0.23/1.3**	3 x **SPC 2-0.23/2.7**	3 x **SPC 2-0.23/2.7**
30 - 40kW	9 kVAR	0 – 20.1kVAR	3 pieces	3 x **SR-230/3**	3 x **SPC 2-0.23/1.3**	3 x **SPC 2-0.23/2.7**	3 x **SPC 2-0.23/2.7**
30 - 40kW	15 kVAR	0 – 20.1kVAR	3 pieces	3 x **SR-230/5**	3 x **SPC 2-0.23/1.3**	3 x **SPC 2-0.23/2.7**	3 x **SPC 2-0.23/2.7**
40< P < 52kW	9 kVAR	0 – 26.1kVAR	3 pieces	3 x **SR-230/3**	3 x **SPC 2-0.23/1.3**	3 x **SPC 2-0.23/2.7**	3 x **SPC 2-0.23/4.7**
52< P < 65kW	9 kVAR	0 – 32.1kVAR	3 pieces	3 x **SR-230/3**	3 x **SPC 2-0.23/1.3**	3 x **SPC 2-0.23/4.7**	3 x **SPC 2-0.23/4.7**
65< P < 80kW	15 kVAR	0 - 42.3kVAR	3 pieces	3 x **SR-230/5**	3 x **SPC 2-0.23/4.7**	3 x **SPC 2-0.23/4.7**	3 x **SPC 2-0.23/4.7**

Depending on the inductive power requirement of the system, the number of reactors can be added to unused outputs. Capacitors may not be installed unless the system requires capacitive loading. In this case, the device operates only with reactors, ie in TCR mode. Fault LEDs (red) for the outputs, not connected to the reactor, are continuously turned on. This does not prevent the device from functioning.

Single module - Single phase connection

The third of the voltage inputs must be connected to the same phase. The current transformer must be connected to the relevant phase. Regardless of the phase to which it is connected, the secondary terminals of the current transformer must be connected to the inputs k1, I1 as shown in the above scheme. Each module is implemented by connecting to the only one different phase. Reactors and capacitors connected to each of the module outputs can compensate that phase up to 15 KVAR in total. Therefore, when a module is used for each phase, a total of up to 45KVAR can be compensated.

OPERATING

When energized, it checks whether three phases are connected. If the same phase is connected to all voltage inputs, the device works in single phase operation mode. It then learns the power of the capacitors and reactors with perfect accuracy in a short period of time. Meanwhile, the operating and fault LEDs are flashing on from right to left and left to right. When learning is completed, compensation starts immediately. After this step, the system compensation is controlled by the SUPER SVC. If there are unconnected reactors or capacitors, it warns by turning on the corresponding fault LED.

The device controls capacitors and reactors according to requirement. The device compensates the system with the smallest powerful reactor. If more than one reactor is connected and the power of the single reactor reaches '80%', it will continue to control together with the other reactor not in use as equally. In this way, the reactor is not used at maximum power and overheating is prevented. If three reactors are connected, the above rule applies.

It is advisable to make the selection according to the following rule for the system to work perfectly.

Rule: **Reactor Power > Capacitor Power**

R* : If the facility requires more inductive compensation, reactors could be added to the these outputs.

- MARKETS
- RESTAURANTS
- HOTELS
- BANKS
- SCHOOLS
- STUDENT RESIDENCE
- GOVERNMENT OFFICES
- FUEL STATIONS

APPLICATION For Facilities with power greater than 80 kW

Single module - Three phase connection

THE IDEAL AND ECONOMIC SOLUTION FOR THE MEDIUM AND LARGEST FACILITIES

It is added in parallel to the classic compensation project and it makes intermediate reactive values that the system can not solve. as zero.

Current transformers can also be connected in series to SVC and VARKOMBI type power factor controllers.

The capacitors and reactors values to be selected are determined according to the suddenly changing load power in system.

Selection Table

SUPER - SVC

REACTOR	CAPACITOR
SR-230/1.5	SPC 2-0.23/1.3
SR-230/3	SPC 2-0.23/2.7
SR-230/5	3SPC 2-0.23/4.7

Reactor Power > Capacitor Power

Commissioning

First of all, warnings must be read carefully and connections should be made according to the scheme.

Before the SUPER-SVC is energized, the VARCOMBI is activated and the capacitor values are learned. The following settings should be checked from the menu while VARKombi is working.

1- Continuous current direction learning function must be disabled.

2- Continuous capacitor power learning function must be disabled.

3- Tanφ 0.0 or cosφ 1.00 should be set.

SUPER-SVC can be activated after the above operations have been performed.

OPERATING

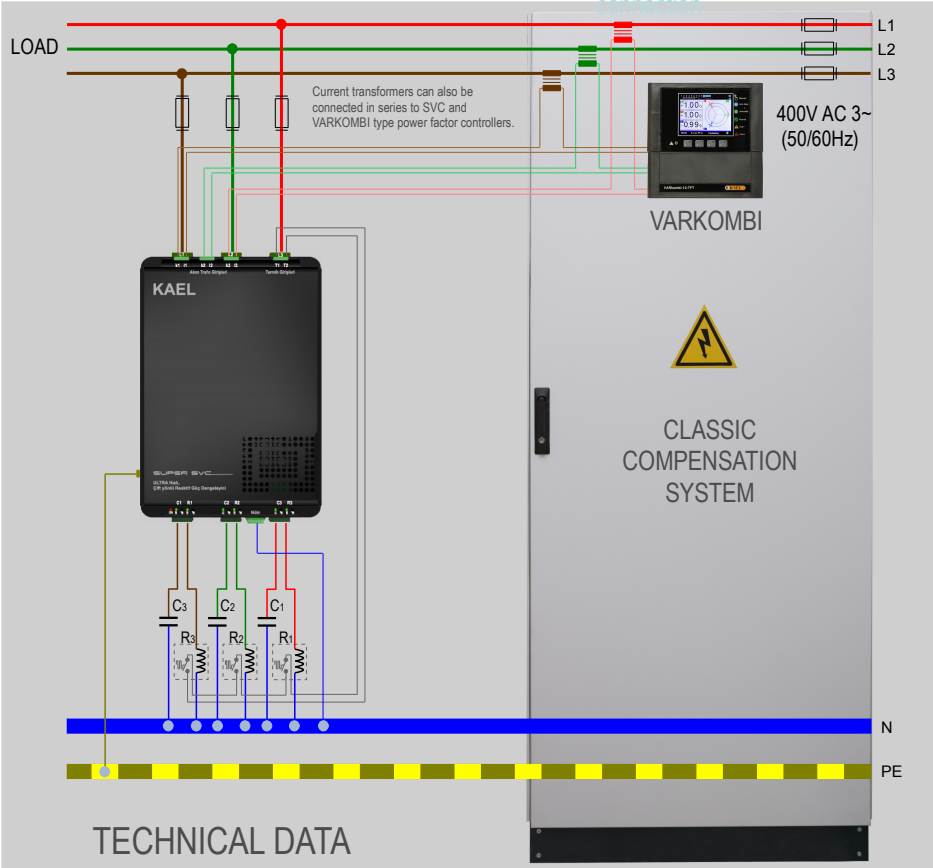
When it is energized, it firstly checks whether three phases are connected. If there are three phases, the device finds the direction of the transformers current. It then learns the power of the capacitors and reactors with perfect accuracy in a short period of time. Meanwhile, the operating and fault LEDs are flashing on from right to left and left to right. When learning is completed, compensation starts immediately. After this step, the system compensation is controlled by the SUPER SVC and VARKOMBI.

Due to SUPER-SVC fast response, if any load is added or leaves the system, it reacts immediately. If the system reactive requirement is bigger than reactor power connected to the SUPER-SVC, in this case VARKOMBI helps to compensate the system. Then SUPER-SVC controls the system again and drives reactive power consumption to zero. If there are unconnected reactors or capacitors, it warns by turning on the corresponding fault LED.

RESERVE

Current Transformer Setting Table

5000/5	1250/5	300/5	50/5
4000/5	1200/5	250/5	40/5
3200/5	1000/5	200/5	30/5
3000/5	800/5	150/5	25/5
2500/5	750/5	125/5	20/5
2000/5	600/5	100/5	15/5
1600/5	500/5	80/5	10/5
1500/5	400/5	60/5	5/5



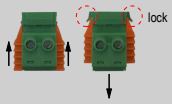
TECHNICAL DATA

Stand-alone usage	✔ Up to 15 KVAR ✔ Up to 45KVAR if one module is connected to a phase
Total maximum reactive power in three-phase connection	 = ± 15 KVAR

Single module - Three phase connection
Each phase is bi-directionally independently compensated to each other. A reactor and a capacitor can be connected 0,5 KVAR to 5 KVAR per phase. It allows to use large reactive power with a single module instead of several modules for each power.
At the beginning, if a reactor with a low-power reactor is selected and the reactor requirement increases, there is no need to buy another module. Only changing reactors and capacitors suffices.
The device automatically learns the power of capacitors and reactors whenever it is energized.
It can be used alone in all facilities with power up to approx. 30 kW in this usage.

Total maximum reactive power in sinle-phase connection	 = ± 45 KVAR

Single module - Single phase connection
Each module is implemented by connecting only to one different phase.
In this case, each module can compensate up to 15 KVAR.
Therefore, when a module is used for each phase, a total of 45KVAR is compensated.

Automatic learning of capacitors and reactors power values	It automatically learns when it is energized. Thus, the reactor or the capacitor can be connected to the desired power per phase. RULE: In order to provide the ideal operation, it is necessary to select the **reactor power ≥ capacitor power.**
Over current protection	✔ 30A per line
Thermal protection (for reactor)	✔
Thermal protection (for thyristors)	✔ SUPER SVC stops its operation if the temperature of the aluminum cooler reaches 95ºC. When it's cold, it starts working again. It is recommended to use cooling fans inside the panel.
No output connection or broken alarm	✔ This alarm is activated if the capacitor and / or reactor are not connected to the outputs or if any of these cables are disconnected during operation.
Connection error (current transformer is in wrong phase)	✔ If the current transformer and the voltage are not in the same phase, the operating and fault LEDs of that phass are continuously flashing on from left to right and right to left.
Connection error (for voltages)	✔ **Single module - Three phase connection:** Three phases must be connected to the voltage inputs. Otherwise, this alarm occurs. **Single module - In single-phase connection:** Three of the voltage inputs must be connected to the same phase. Otherwise, this alarm occurs.
Operating voltage	400V AC 3~ (50Hz) Un x (0,9 – 1,1)
Maximum voltage	440V AC 3~ (50Hz)
Switching time	5 – 20 ms
Display	LED
Ambient temperature	-20ºC - +60ºC
Dimensions	133 x 200 x 200 mm
Plugging in and removing the socket	Plug-in socket  The orange handles on the side are plugged into the socket when it is in the back position. In this case it is firmly locked Removing the socket  lock In order to remove the socket, first the orange handles on the side are pushed forward in the direction of the arrow and the lock is opened, in this case the terminal is pulled backward.