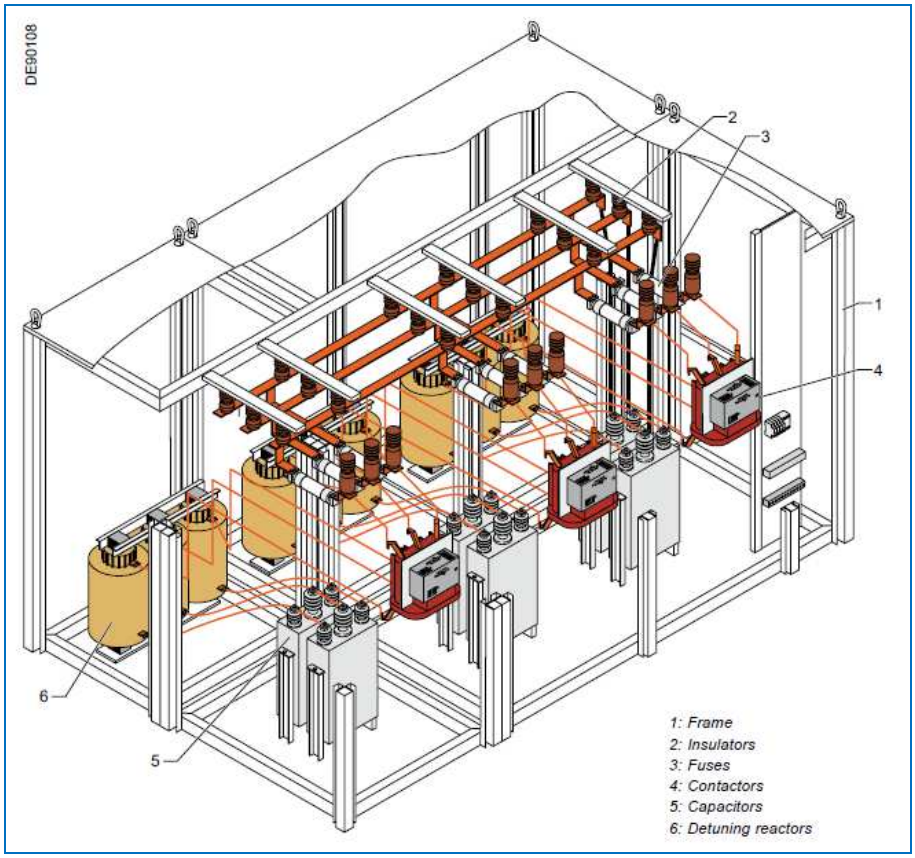
Technical Specification

CP253 SAH

Automatic, delta connected capacitor bank
with detuning reactors
(Network up to 12KV)



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V1	First version	T. Le Guillou			24/08/2015
V2	Minor corrections	T. Le Guillou			28/08/2015
V3	Minor corrections	T. Le Guillou			09/10/2015
V4	Change controller to VarPlus Logic	T. Le Guillou			28/01/2016

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Note: In this specification, texts in green are related to “non standard” options that are available on request.

Introduction

CP253 SAH is one range of Schneider Electric medium voltage capacitor banks.

It is produced in a factory located in France (74 – Pringy).
Like all its units, this Schneider Electric factory has an operating organization whose main role is to verify quality and ensure compliance with standards.
This procedure is:

- uniformed for all departments;
- recognized by numerous customers and official organizations.

But, above all, its strict application has made it possible to obtain the recognition of an independent organization: French QA management organization: AFAQ (Association Française pour l'Assurance Qualité).

The quality system for design and manufacturing is certified in compliance with the requirements of the ISO 9001 Quality Assurance model.
This factory is also ISO9002 and ISO14001 certified.

General presentation

CP253 SAH capacitor bank is built in a stand-alone enclosure with PROPIVAR NG capacitor units, medium voltage contactors, detuning reactors and other optional components as described in this specification.

It is an automatically controlled capacitor bank made of several capacitor "stages" controlled by a power factor relay. The capacitor units are delta connected.

1. Scope of work

The following works are included in our scope of supply:
- Design of the capacitor bank,
- Manufacture of the capacitor units and shop assembly (*) of the capacitor bank,
- Routine tests of the capacitor units as per IEC 60871 at the factory,
- Inspection and testing of the capacitor bank at the factory (*) (as per our ITP document),
- Supply of documents and drawings as listed in chapter "3. Documents"

(*) In some cases (particularly when we provide single phase, air core type detuning reactors) the detuning reactors are separately delivered and the full assembly of the capacitor bank is only done at site.

Unless specifically listed, quoted and purchased as part of the contract, the following works are NOT included in our scope of supply:
- Electrical studies: Network stability, harmonics, power factor correction, selectivity, inrush currents, transients,
- Type tests and any other special test,
- Energising of the power circuit (MV) and performance of operation tests of the capacitor bank at the factory,
- Seismic withstand studies and tests,
- Short-circuit withstand calculations and tests,

2. Standards

The CP253 SAH equipment are designed, manufactured and tested according to relevant IEC recommendations.

Capacitor bank:
IEC 60060-1: High voltage test techniques – Part 1: General definitions and test requirements.
IEC 60815: Guide for the selection of insulators in respect of polluted conditions
IEC 60529: Degrees of Protection Provided by Enclosures
IEC 61000: Electromagnetic Compatibility (EMC)

Capacitor unit:
IEC 60871-1: Shunt capacitors for A.C. power systems having a rated voltage above 1000 V – Part 1: General
IEC 60871-2: Shunt capacitors for A.C. power systems having a rated voltage above 1000 V – Part 2: Endurance test
IEC 60871-4: Shunt capacitors for A.C. power systems having a rated voltage above 1000 V – Part 4: Internal fuses
In addition our PROPIVAR NG capacitor units also comply with BS 1650, VDE 0560, C22-2 N° 190-M1985, NEMA CP1

All components used inside the equipment are also complying with their relevant IEC standards.
Contactor: IEC 60420, IEC 60470,
Line disconnecting switch (When applicable): IEC 62271-1, IEC 62271-102,
Earth switch (When applicable): IEC 129C,
Reactor: IEC 60076-6, IEC 60289,
HRC Fuses: IEC 60549, IEC 60282-1, IEC 60787
Current transformer (When applicable): IEC 61869-1 and 2, IEC 60044,
Voltage transformer (When applicable): IEC 61869-1 and 3,
Surge arrester (When applicable): IEC 60099-4,
Power factor controller: IEC 60010-1, IEC610006-2 and 4, IEC61326-1, UL61010,
Protection relays: IEC 60255, IEC 60010

3. Documents

In case of contract the following documents will be provided:

- Routine test report for the capacitor banks,
- Routine test report for the capacitor units,

- Drawings and diagrams (*) for each type of capacitor bank, including:
    - Component list,
    - Dimensional drawing and general layout,
    - Foundations details,
    - Power circuit diagram (Single line diagram)
    - Protection circuits diagrams,
    - Control circuits diagrams,
    - Terminal blocks details,
    - Capacitor bank nameplate details,
    - Interlocking (When applicable),
    - Protection settings,

(*) Unless otherwise specified and agreed in the contract the drawings and diagrams will be done using Schneider Electric standard format.

- Installation and Maintenance manuals,

If required and agreed in the contract we can also provide the following documents:
- Technical specification (for each type of capacitor bank),
- Data sheet (for each type of capacitor bank),
- Manufacturing schedule (Bar chart type),
- Inspection and testing procedure (ITP),
- Site Tests and Commissioning instructions,

- Routine test certificates for main components: Contactors, Reactors, Current Transformers (When applicable), Voltage Transformers (When applicable), Disconnecting / earth switch (When applicable),Surge arresters (When applicable),

All our documents can be available in French and/or English. (Other languages if specially required and agreed in the contract)

<u>These documents and drawings are cpmpliant with IEC recommendations:</u>
IEC 60617: Graphical Symbols for Diagrams
IEC 60050: International Electro-technical Vocabulary

4. Technical characteristics

Here are the technical characteristics and list of available choices and options for the CP 253 SAH capacitor banks. For each item of one project we provide a "Data sheet" which indicates the choices made for each of these characteristics and options.

4.1 Environmental conditions

CP253 SAH capacitor banks are available for **indoor** or **outdoor** installation.

In case of **outdoor** installation a minimum **IP54** Ingress Protection degree shall be used. Also, unless equipment is installed in a sheltered area, **double roof** option shall be selected.

Whatever the installation location, the ambient temperature must remain within acceptable limits.
Several design options, with adapted natural or forced ventilation systems, are available:

	Default value	Also available
Average temperature over 24 h	**+35°C**	**+40°C or +45°C**
Maximum ambient temperature	**+40°C**	**+45°C or +50°C**
Minimum ambient temperature	**-5°C for Indoor type** **-25°C for Outdoor type only**	**-40°C for outdoor type only**

Unless otherwise specified in its Data Sheet, CP 253 SAH is designed for:

- Maximum relative humidity = 95%
- Minimum relative humidity = 35% (other values available on request)

CP 253 SAH is suitable for any site at an altitude **< 1000m**. Design can be adapted for altitude up to **3500m**.

4.2 Electrical network frequency

CP 253 SAH capacitor banks range is available for **50Hz or 60Hz** electrical network.

4.3 Electrical characteristics of the capacitor bank

a) Rated reactive power (**Qn**):

Qn is the reactive power that will be delivered by the capacitor bank at the nominal network voltage (Un).
CP 253 SAH capacitor banks can be designed for a wide range of required reactive power output.
The rating maximum limits depend upon the rated voltage, the rated frequency (50Hz or 60Hz) and the number of stages of the capacitor bank.

Main limitations for the maximum rated reactive power available for one capacitor stage are:

- The maximum rated current of the contactor, (1)
- The quantity and maximum rated power of capacitor unit, (2)
- The maximum rated current of the range of HRC fuses we use for this type of equipment,

Notes:
(1) Customer can choose to use Schneider Electric ROLLARC 400 contactors (SF6) or Schneider Electric CBX-3C contactors (Vacuum). Their normal rated current is 400A but for capacitor bank switching, which requires de-rating and specific testing qualification, they are certified for a 240A capacitive current rating.

(2) 3 is the maximum number of capacitor units connected in parallel per stage so that the HRC fuses ensure proper protection of each individual unit.

The tolerance on the rated power of the capacitor bank is: 0/+10%,
Capacitance variation (ΔC/C) according to temperature is: $-3{,}5.10^{-4}$/°C.

b) Rated voltage (**Un**):
CP 253 SAH capacitor banks are available for any service voltage from **1kV to 12kV**. Other ranges (CP254, CP227, CP230) are available for higher voltage levels.
As per IEC 60871 recommendations, CP 253 SAH capacitor banks are designed for:
- 1,10 x Un overvoltage - 12 hours per day,
- 1,15 x Un power frequency overvoltage - 30 minutes per day,

c) Rated insulation level (**Um**):
Um is the maximum voltage of the power circuit. CP 253 SAH capacitor banks are available with 7.2kV or 12kV rated insulation level.
Here are the related power frequency short duration withstand voltage and lightning impulse withstand voltage. (As described in IEC 60871 Standard)

Highest voltage for equipment Um (kVrms)	Rated power frequency short duration withstand voltage (kVrms)	Rated lightning impulse withstand voltage (kV peak)
7,2	20	60
12	28	75

d) Short Circuit Current (**Ik**):
Ik is the short circuit current to be withstand by the main busbar, the HRC fuses of each step and the components located upstream these HRC fuses in the capacitor bank: incoming circuit-breaker, disconnecting switch (isolator), current transformers at incoming level if any, …
It does not apply to the detuning reactors, capacitors, downstream busbars and connectors or other components located downstream the HRC fuses of each stage.
CP 253 SAH is available with several **Ik** values: **12 – 20 – 25 – 31,5 or 40kA** for **1s** (3) fault current duration.

Ik value is used to calculate the maximum peak inrush current amplitude when switching the capacitor bank and define the minimum inductance values required for limiting these inrush currents to acceptable values.
Detuning reactors always have very high inductance values compared to these minimum inductance requirements, so we usually do not need to make such calculation unless we want to check the transient peak inrush current value for other reasons like, for example, the acceptable limits for switchgear.

Note:
(3) There is no need for withstand duration longer than 1s for the capacitor bank: This is an equipment connected in parallel in the electrical system and the upstream protection (Capacitor bank feeder in upstream MV switchgear) as well as the internal capacitor bank protection (HRC fuses) must ensure disconnection in less than 1 second.

e) Reactor's detuning order / detuning frequency:

The standard detuning reactors used in CP 253 SAH capacitor banks are three-phase, iron core, dry type.

These detuning reactors are manufactured by Schneider Electric factory (BCV) in France (85 – FONTENAY-LE-COMTE).

These are impregnated reactors, (Insulation class: F / Thermal class: F)

Winding conductor is made of aluminium but can also be supplied in copper if required.

The detuning order (n) is usually selected by the customer, consultant or contractor based on a harmonic study or experience and common practice having detailed knowledge of the loads and operating conditions.

Most commonly used detuning orders (n) are: **2,67 – 2,7 – 3,78 – 3,8 – 4,08 – 4,2 – 4,3**

As the detuning reactor description may change from one county to another, here is the table showing the relation between "detuning order" (n), "detuning frequency" and "reactance ratio" (%).

Detuning order	Detuning frequency (Hz)		Reactance ratio XL/XC in %
	50Hz network	60Hz network	
2,67	133,5	160	14%
2,7	135	162	13,7%
3,78	189	227	7%
3,8	190	228	6,9%
4,08	204	245	6%
4,2	210	252	5,7%
4,3	215	258	5,4%

Note:
As detuning reactors generate heat losses and capacitor being very sensitive to temperature, **forced ventilation (fans) is included in all CP 253 SAH capacitor banks**. *(Forced ventilation may be avoided when reactors are installed outside the capacitor bank enclosure => Air core type or Oil type)*

Also available on request:

"Oil type" reactors

If required we can replace "Dry type" reactors by "Oil type" detuning reactors.

Same rules apply for the detuning frequency and inductance values.

With that type of reactor we provide Temperature / Pressure and Oil leakage detection and protection device.

Due to their heavy weight, these reactors are often separately delivered and assembled at site inside the capacitor bank enclosure.

"Air core type" reactors

We can also provide "Single –phase, Air core type" reactors.

Same rules apply for the detuning frequency and inductance values.

In this case, due to magnetic clearance requirements, reactors are installed beside the capacitor bank enclosure.

The 3 single phase reactors can be stacked on each other (see photo) or put side by side on the ground (with their individual supporting insulators).

Cables necessary to connect those reactors to the capacitor banks are not included in our scope of supply.

These reactors are always separately delivered and connected to the capacitor bank only when installed at site.

f) Number of steps:

Naming convention: In this document "Stage" is the physical portion of an automatic capacitor bank (1 stage includes 1 switching device). "Step" is the electrical portion of the automatic capacitor bank. (See below example)

We use to provide automatic MV automatic capacitor banks having **1 to 5 stages** but for industrial applications the most common and cost effective configurations are made of **2 or 3 stages**.
Larger number of stages can also be designed and proposed on request.

Automatic capacitor banks with **1 single stage** are mainly used for power factor correction of one big MV motor. The automatic disconnection of the capacitor bank by its own contactor avoids self excitation risk when the motor is stopped.

g) Regulation sequence:

The regulation **sequence** defines the reactive power for each stage compared to the first one.

IMPORTANT NOTE: The new VarPlus Logic controllers can manage **any different steps sizes combination**. We are not limited to the combinations provided in below table. Steps can have values different from an integer multiple of the first step. (For example it can manage configurations like 100 + 150 + 340 + 500kvar …)

Example:

With 3 capacitor stages of respectively 100, 200 and 200kvar (Totally 500kvar) we can use the 1-2-2 regulation sequence of the power factor controller to obtain one 5 steps (5 x 100kvar) automatically regulated capacitor bank.

- Step 1 = Stage 100kvar "on"
- Step 2 = Stage 200kvar "on"
- Step 3 = Stage 100 + Stage 200kvar "on"
- Step 4 = Stage 200 + Stage 200kvar "on"
- Step 5 = all 3 Stages "on"

Regulation sequence right choice optimizes cost and size of a solution requiring several electrical steps.

Quantity of stages	Default recommended sequence / Steps quantity	Also available (Examples, not limited to this list)
1 stage	1 / 1 step	
2 stages	1-2 / 3 steps	1-1 / 2 steps
3 stages	1-2-2 / 5 steps	1-1-1 / 3 steps 1-1-2 / 4 steps 1-2-3 / 6 steps 1-2-4 / 7 steps
4 stages	1-2-2-2 / 7 steps	1-1-1-1 / 4 steps 1-1-2-2 / 6 steps 1-1-2-3 / 7 steps 1-2-3-3 / 9 steps 1-2-3-4 / 10 steps 1-2-4-4 / 11 steps
5 stages	1-2-2-2-2 / 9 steps	1-1-1-1-1 / 5 steps 1-1-2-2-2 / 8 steps 1-1-2-3-3 / 10 steps 1-2-3-3-3 / 12 steps 1-2-3-4-4 / 14 steps 1-2-4-4-4 / 15 steps

4.4 Auxiliary voltages

We do not have auxiliary power supply inside the capacitor banks. The power supply must be made available at site where the capacitor bank is to be connected.

	Default value	Also available
For protection and control circuits (*)	**110 Vdc**	**Vac: 110 / 127 / 230V** **Vdc: 24 / 48 / 60 / 125 /220V**
For the contactors (**)	**110 Vdc**	**Vac: 110 / 127 / 230V** **Vdc: 24 / 48 / 60 / 125 /220V**
For space heaters and ventilation fans (***)	**230 Vac (220-240)**	

(*) Protection and control circuits include the protection relays (if applicable) and the power factor controller. SEPAM C86 protection relays shall be supplied with DC Voltage only.

(**) ROLLARC contactor cannot be supplied with 24 VAC.

(***) Forced ventilation with fans is included in all capacitor banks including detuning reactors. *(Forced ventilation may be avoided when reactors are installed outside the capacitor bank enclosure => Air core type or Oil type)*

4.5 Capacitor units

Three phase unit

CP 253 SAH capacitor banks are using PROPIVAR NG, three-phase, delta connected capacitor units.

1, 2 or 3 of these capacitor units are connected in parallel in each stage of the bank.

Notes:
To ensure proper protection with the HRC fuses, there will not be more than 3 units connected in parallel per stage.

These capacitor units do not have internal fuses.
Internal fuse technology is not suitable for delta connected capacitor units.
It only applies to single-phase or double-phase capacitor units in double star connected banks.

Three-phase capacitor

Technology:	All film capacitors
Internal delta connection	
Location:	Outdoor or Indoor
Reactive power:	Up to 600 kvar
Operating frequency:	50 Hz and 60Hz
Capacitor voltage range:	1-12 kV for network from 2.4 to 12 kV - used in delta connection
Current:	Max. 160 A
Low losses	< 0.2 W/kvar
Internal fuses	No
Discharge resistors:	Built-in, standard residual voltage 75 V - 10 min. (option for 50 V - 5 min.)
Dielectric film:	Polypropylene
Dielectric liquid:	Jarylec C101
Bushings:	3 - Porcelain
Terminals:	M16 x 20
Mounting brackets:	Yes – On both sides
Temperature range:	-25°C to +45°C / +50°C /+55°C (-40°C on request)

As per IEC 60871, power capacitor units have internal discharge resistors so that the voltage will go down to less than 75V within 10 minutes after they are de-energized.
Also available: Some other international standards (AS2897 for example) ask for a discharge to 50V in less than 5 minutes. We can offer this option with not impact on the price of the solution.

4.6 Power circuit

a) Busbars and connections:

In our CP 253 SAH capacitor banks we propose bare copper bus-bars supported by epoxy type insulators.

Also available on request:

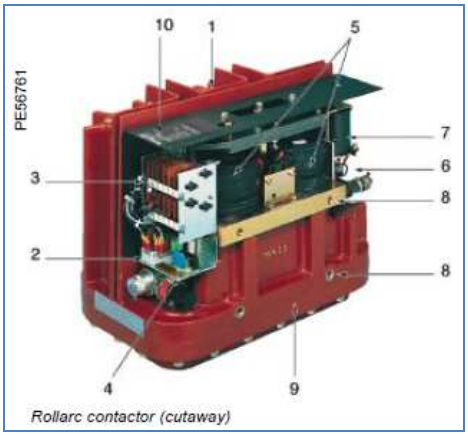
When required by our customers we can also provide the following:

- Tin-plated connections and terminals of the copper busbar,
- Tin-plated busbars,
- Insulated busbars,
- Porcelain supporting insulators,

b) Contactors:

In our CP 253 SAH capacitor banks we can offer **SF6** or **Vacuum** contactors.

For SF6 type we use the ROLLARC type contactor.



Rollarc contactor (cutaway)

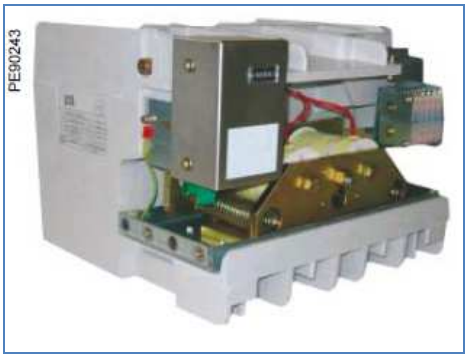
Electrical characteristics

Rated voltage U_R (kV) 50/60Hz kV	Insulation level Inpulse 1,2/50µs kV peak	1 mn 50/60Hz kV rms	Breaking capacity kA	with fuses kA	Rated current I_R A	Making capacity kA peak	with fuses	Short-time thermal current 3s kA	Mechanical endurance kA rms
7,2	60	20	10	50	400	25	125	10	100 000 operations
12	60	28	8	40	400	20	100	8	

Maximum operable power

Voltage (kV)	Without fuse Power (kvar)	With integrated fuse Power (kvar)
3,3	1255	790
4,16	1585	800
6,6	2510	1270
10	3810	960
12	4570	1155

For Vacuum type we use the CBX-3C contactor



Electrical characteristics

		CBX3-C
Rated Voltage (kV)		7.2 / 12
Power frequency withstand voltage (kV)		20 / 28
Impulse withstand voltage (BIL) (kV)		60 / 75
Capacitive load	Rated operating current (A)	400
	Maximum capacitor bank rating (kvar)	3360 / 5600
	Inrush current (kAp)	20
Short time withstand current	1 s (kA)	4
	Peak on ½ cycle (kAp)	25
Mechanical endurance (N°)		3 millions
Electrical endurance at rated current (N°)		500 000
Temperature range (°C)		-5 to +40
Number of poles		1P - 3P

c) Fuses:

Each stage of a CP253 SAH capacitor bank has a HRC fuses protection. The fuse rating is estimated for a tender proposal. In case of contract it is more accurately calculated by our technical department (calculation based on Short circuit power of the network, quantity of capacitor banks operating in parallel, etc …).
Then it may be slightly different from the information provided in the proposal.

If required, a calculation note can be provided with the contractual documents.

The blown fuse indication principle is to use the pin striker of the HRC fused to activate a contact. This contact can then be used to switch off the step and/or provide an alarm.

d) Quick discharge coils **(Optional item):**


Quick discharge reactors

This option consists in having one set of 2 discharge coils per stage of the automatic capacitor banks

This option is offered when the tender specification requires a quick discharge time: For example a full discharge of the capacitor bank in less than 10s.

In that case we provide 2 coils (VT's without secondary) connected between phases for each step of a capacitor bank.

IMPORTANT NOTE:
This option is not to allow quick connection and disconnection of the steps as these coils need time for cooling! It is absolutely necessary to keep the minimum requirement of 300s time delay setting for the control of the steps.

e) VPIS **(Optional item):**

Voltage Presence Indication System
This is a system made of insulating holders with capacitive dividers that provide mechanical support and insulation.

The embedded capacitors in the insulating holder provide voltage output to indicate the voltage presence. (Up to 24 kV)

The VPIS display part made of 2 parts:

- The indication part using LEDs, replaceable for maintenance,
- Surge protection part, always connected,

f) Surge arresters **(Optional item):**

This option consists in the addition of one set of 3 surge arresters at the incoming of the capacitor bank.

The surge arresters are connected phase to ground for each phase.
Surge counter can be added as a special request

On request we can also provide surge arresters for each stage of the capacitor bank.

g) Line disconnecting switch and earth switch **(Optional item):**

Line disconnecting switch is an optional item.
It can be combined with an earth switch. (Mechanically interlocked)

When provided, the default location of the earth switch is on the capacitor bank side but if required it can be positioned on the cable incoming side.

Earth switch can also be selected alone.

h) Grounding:

We use the capacitor bank aluminium chassis for grounding. It's a welded unpainted aluminium frame.
2 grounding pads are provided (one on each side of the capacitor bank enclosure)

Also available on request:
When specifically required by our customers we can also provide a separate copper earth circuit inside the capacitor bank enclosure.

(If not specifically required, our standard equipment does not have this separate copper bar).

4.7 Protection and control

a) Protection and control compartment / box:

The basic control and protection system includes the power factor controller and the signalling lamps

Monitoring and control unit
1. Varlogic power factor controller
2. Sepam digital protection relay

For indoor type capacitor banks: the control and protection devices can be "Door mounted" for IP21 capacitor bank. Otherwise it shall be inside a LV compartment of the capacitor bank" (IP23 to IP54) or in a separate "Control Box".

For outdoor type capacitor banks: the control and protection system can be "Inside bank" or in a separate "Control Box"

Also available on request:

- Short-circuit / Over-current / Overvoltage protection relays (May also need to add CT's and VT's).
- Auto-Manual selector switch (Need also to add push buttons for manual operation)
- Power Quality meter,

In some cases customer ask us to remove the protection and control system from our scope of supply. Then all control and protection wirings are connected to a terminal block.

b) Power factor controller:

The new VL6 or VL12 VarPlus Logic controllers bring a lot of data, alarms and possibilities. (See beside table and see chapter 4.3.g for information about sequences)

These controllers have a RS485 MODBUS communication port.

The power factor controller requires a 90 to 550V reference voltage input and a 15mA to 6A reference current input.

Common practice is to use the reference current from Phase 1 and the reference voltage between phase 2 and 3.

VarPlus Logic VL series
User manual

Technical data

Technical characteristics

Type	Description
Voltage (common supply and input)	90 - 550 V, 1ph, 50/60 Hz, 6 VA 300 V LN / 519 V LL CAT III or 550 V CAT II.
Current	15 mA - 6 A, 1ph, < 1 VA, 100 A - 1 s
Control outputs (step output)	VL6: 6 relays VL12: 12 relays NO contact: 250 V LN or LL CAT III 48 V DC / 1 A, 250 V AC / 5 A Common root: 10 A max
Fan control	Relay, NO normal open contact: 48 V DC / 1 A, 250 V AC / 5 A
Alarm contact	The relay contact is open when the controller is energized with no alarm and will close in the event of an alarm. The relay is NC (Normally Closed) when the controller is not energized. Rating : 48 V DC / 1 A, 250 V AC / 5 A
Digital Input for Cos phi 2 target	Dry contact (internal supply 5 V, 10 mA)
Modbus RS485 serial port (RTU)	Line polarization / termination, not included
Interface TTL	For internal uses only
Temperature for operation	–20 °C +60 °C
Internal Temperature probe	Yes
Storage	–40 °C +85 °C
Humidity	0 % - 95 %, without condensation for operation and storage
Maximum pollution degree	2
Maximum altitude	≤ 2000m
Connection	Screw type, pluggable. Section: 0.2 - 2.5 mm^2 (0.2 - 1 mm^2 for Modbus and digital input)
Case	Front: instrument case plastic RAL 7016 Rear: metal
Degree of Protection	Front: IP41, (IP54 by using a gasket) Rear: IP20
Weight	0.6 kg
Size	144 x 144 x 58 mm (H x W x D)
Panel Cutout	138 x 138 (+0.5) mm, thickness 1 – 3 mm
Protection against voltage dips	Automatic disconnection of steps for dips > 15 ms (protection of capacitor)
Display	LCD graphic 56 x 25
Alarms log	5 last alarms
Distortion	H1 to H19
Measurement displayed and accuracy	U, I, F, …: ±1 % S, P, Q, DQ, PF, Cos phi, THDU: ±2 % U harmonics (H3 to H19): ±3 % Internal Temperature: ±3 °C
Standards	IEC 61010-1 IEC 61000 6-2 IEC 61000 6-4 IEC 61326-1 UL 61010
Conformity and listing	CE, NRTL, c NRTL, EAC
Program algorithm	AUTOMATIC (best fit) LIFO PROGRESSIVE
Regulation setting	From Cos φ 0.7c to 0.7i
Reconnection time	From 1 to 6500 s
Response time	From 1 to 6500 s
CT range	Primary range: up to 9600 A Secondary range: 1 A or 5 A.

c) Protection relays **(Optional items):**

Sepam protection relays

For our Medium Voltage capacitor banks we use Schneider Electric SEPAM range of protection relays.

When this option is required for CP253 SAH capacitor bank we propose the "SEPAM C86" type.

This relay also has a RS485 Modbus communication option.

d) Overload (50/51) / Thermal image (49 rms) / Short-circuit current (50/51)

Current Transformer

Most of the time, customer's electrical system has one dedicated feeder to supplies the capacitor bank. This feeder usually includes overload and short-circuit protections.

When not available upstream we can add these protections inside the capacitor bank. We can use 2 CTs only if we know the system is well balanced or 3 CTs in other cases. 5A or 1A secondary current output has to be selected

e) Overvoltage (59) and under-voltage (27)

Phase-earth Potential Transformer

Most of the time, customer's electrical system has one dedicated feeder to supplies the capacitor bank his MV switchboard. This switchboard already usually includes overvoltage protection.

When not available upstream we can add these protections inside the capacitor bank. We use 2 VTs connected between phases, at the incoming side of the capacitor bank.

4.8 Enclosure

a) Enclosure type (panels and doors)

For CP253 SAH capacitor banks, our preferred type of enclosure is a welded aluminium frame with unpainted aluminium bolted panels. There is only one door for access to the LV compartment.
Aluminium is perfectly suitable for indoor and outdoor installation.
Panels and doors thickness is 2 mm.
We provide lifting rings for capacitor banks part handling.

Also available on request:

- Steel enclosure: 1,5mm thickness steel doors and panels (*).
- Steel enclosure: 2mm thickness steel doors and panels (*).
- "Painted aluminium" option (Only panels and doors are painted) (*)
- "Painted steel" option (Only panels and doors are painted) (*).
- Available colours: RAL 7032, RAL 7035, RAL 9002 (We can also provide any other RAL colour).
- Supporting base frame (Aluminium or galvanized steel) for the whole capacitor bank in order to ease the installation work at site.

(*) Frame remains made of unpainted aluminium. If specified we can replace the aluminium frame by a galvanized steel frame.

b) Ingress Protection index (IP)

For indoor type, depending on the environment and customer specification we can offer IP21, IP23, IP42 or IP44 (Depending on the range some of these option may not be available).

For outdoor type capacitor banks we strongly recommend to use IP54 enclosures and the "Double Roof" option. When capacitor bank are installed outdoor but under a shelter (protected from rain and sun) we can remove the double roof option.

Also available on request:

- IP55 Ingress Protection index

c) Space heaters and ventilation

We always provide space heaters (also named heating resistors or anti-condensation heaters) inside our outdoor type capacitor banks.
There is a thermostat that will switch on the heaters as soon as the temperatures go too low.
Thermostat will also turn on the ventilation fans as soon as temperature rises over the maximum threshold.

These space heaters are optional for indoor type capacitor banks.

Forced ventilation with fans is included in all capacitor banks including detuning reactors and cannot be avoided.

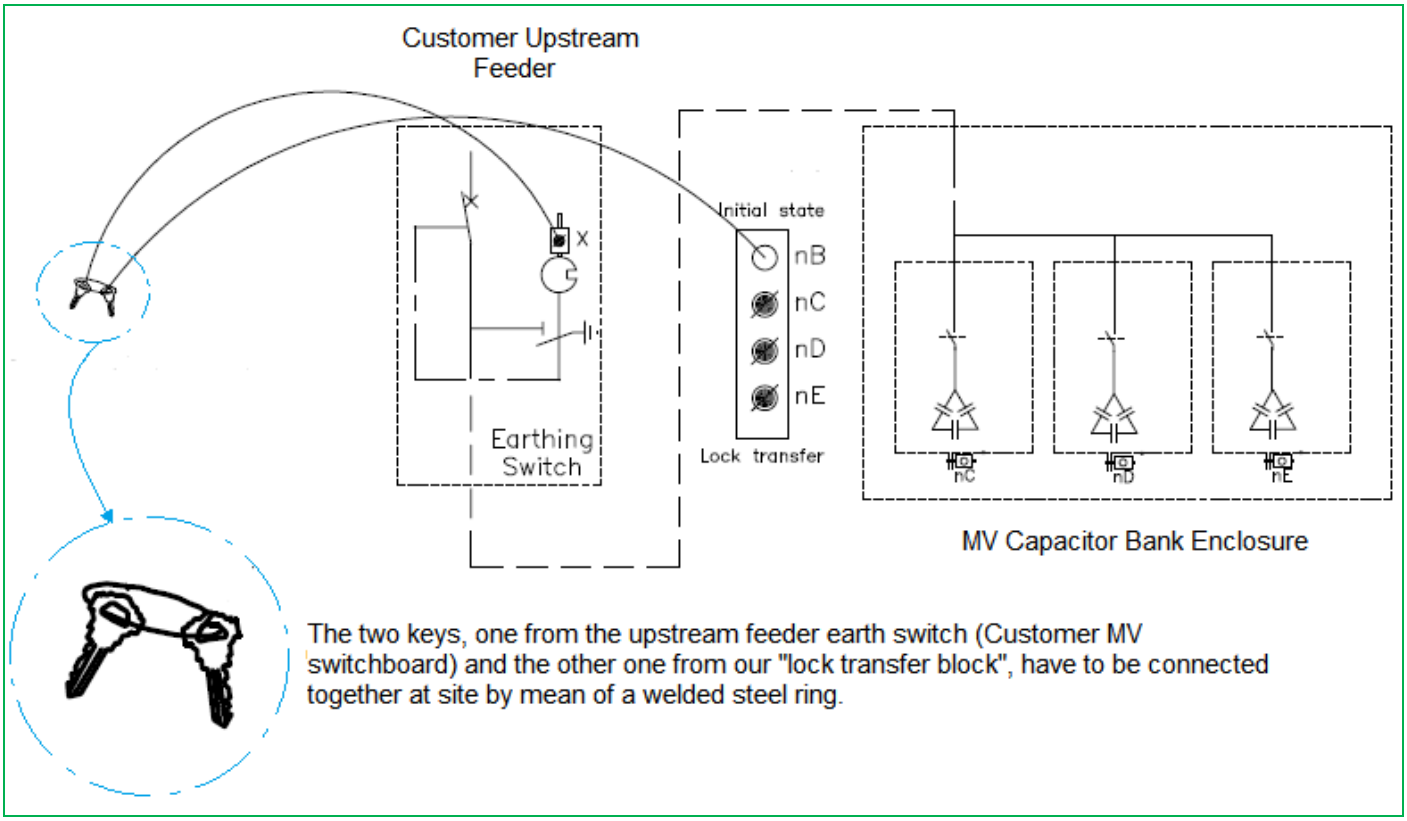
d) Access to MV compartment - Interlocking

The default proposal for our CP253 SAH capacitor banks is an enclosure with removable panels on all sides.
The LV compartment of the capacitor bank is always a door (2 latching points)

Also available on request:

- Front door and/or rear door for each step, (800mm width), providing direct access to the MV part of the capacitor bank.
- Interlocking using PROFALUX or RONIS / ISS keys and lock transfer blocks. (On request, the Lock Transfer Block can also include a timer to keep keys for the duration of the safety discharge time)

INTERLOCKING TYPICAL DIAGRAM



INTERLOCKING SEQUENCE:

1 - Open the Circuit-Breaker of the upstream cubicle.

2 - Close the Earth Switch of the upstream cubicle to release key set "key X / key nB".

3 - Bring "key X / key nB" to Lock Transfer Block and use "key nB" to release "key nC", "key nD", "key nE", ...

4 - Wait for the safety discharge time (*) before going to open the doors of the capacitor bank.

5 - Use the key ("key nC", "key nD", "key nE", ...) to open relevant door(s) of capacitor bank.

6 - While the door is open, the relevant key remains captive.

(*) Safety discharge time is usually 10 minutes for MV capacitor banks

e) Lighting

In our default standard offer there is no lighting inside the capacitor bank.
We can add lighting in the LV compartment and/or in the MV part of the capacitor bank.
We provide neon type of lighting. It is controlled by a door contact switch.
We can also provide a socket for LV power supply.

f) Capacitor bank nameplate

In our default standard offer we propose a PVC capacitor bank nameplate.

Also available on request:

- Stainless steel nameplate option if required.

g) Low voltage wiring

Low voltage wiring is insulated with black PVC, 1000 V grade, with the following cross-sections:

- 2,5 sq. mm for currents circuits,
- 1,5 sq. mm for voltage circuits.

Each extremity of wire is marked using the independent marking system.

5. Factory tests

Each CP253 SAH capacitor bank has to pass routine testing before delivery. The factory routine tests are performed according to IEC 60871 recommendations and include the following:

5.1 PROPIVAR NG capacitor units :

- capacitance measurement,
- loss angle measurement (tg δ),
- sealing test,
- internal discharge resistor value checking,
- voltage test between terminals,
- voltage test between terminals and container.

5.2 CP253 SAH capacitor banks

- phase to phase capacitance measurement,
- insulation measurement,
- conformity checking,
- functional test (off-load operation),