CapCube
Medium voltage power factor correction solution for OEMs
### Why improve power factor?
- Reduce electricity charges
- Reduce energy losses
- Increase network capacity
- Economically plan new electrical infrastructure
- Reduce voltage drop
- Reduce the effects of starting large machines

### How do you improve power factor?
A capacitor generates reactive power. When connected to an apparatus which requires reactive power, the load on cables and transformers is relieved, thereby increasing the transmission capacity of active power.

**Figure 1:** Uncompensated Load

\[
\cos \phi = \frac{P}{S}, \quad \sin \phi = \frac{Q}{S}, \quad \tan \phi = \frac{Q}{P}
\]

**Figure 2:** Compensated Load

\[
Q_c = P \left( \tan \phi_1 - \tan \phi_2 \right)
\]
\[
\tan \phi = \sqrt{\frac{1}{\cos^2 \phi} - 1}
\]

Figure 1 shows the relationship between apparent (S), active (P) and reactive power (Q) at a certain power factor (cos \(\phi\)) of the load. The load is uncompensated and if the conductor or the transformer is fully loaded the arc of the circle defines the maximum power output.

Figure 2 shows the reactive output (Q) from the power supply network reduced by the capacitor output (Qc) to (Q1) when applying power factor correction. The total load on the power supply network is reduced from (S) to (S1) at an unchanged active power output.

With the capacitor in service additional machines now may be connected, i.e. the load may be increased. Figure 3 shows an increase of active load from (P) to (P'). The capacity of the conductor or the transformer is fully utilised when (S2) equals (S).

### Where to use power factor correction?
Capacitors can be connected at different points in the network to improve the power factor of one or many loads. Each of these methods are a part of the ABBACUS solution.

**Central Compensation**
When the main purpose is to reduce reactive power purchased due to power supplier’s tariffs, central compensation is preferable.

**Group Compensation**
Group compensation instead of central compensation is preferable if sufficiently large capacitors can be utilised. In addition to what is obtained at central compensation, load on cables is reduced and losses decrease.

**Individual Compensation**
The special advantage with individual compensation is that existing switching and protective devices for the machine to be compensated can also be utilised for switching and protection of the capacitors.
ABB’s value added CapCube solution is ideal for inrush power factor correction (PFC) units of up to 12kV.

The CapCube solution successfully integrates an inrush PFC capacitor bank of up to 1 Mvar within a conventional UniSafe switchgear platform. This type of solution is ideal for medium voltage motor control centre (MCC) applications or any inrush PFC applications up to 12 kV.

The CapCube enables OEMs to expand their medium voltage product portfolio and offers customers a truly competitive product that combines a PFC unit with their existing switchgear line up.

OEMs with an established medium voltage air insulated switchgear (AIS) customer base will also benefit from the additional PFC solution with minimal effort and outlay.
Key components

**ABB Capacitors**

The ABB capacitor unit is designed for heavy-duty operation in outdoor, enclosed and pole mounted capacitor banks in all climatic conditions.

The capacitors are impregnated with a biodegradable, non-PCB fluid with high insulation strength to ensure excellent electrical performance. The edges of the foil electrodes are folded enabling the unit to withstand high transient currents and minimising partial discharge. This ABB process is superior to all other methods employed. ABB capacitors have an extremely low failure rate and high reliability.

The ABB capacitor tank is constructed from a high-grade stainless steel providing excellent corrosion resistance. The seams are fully robot TIG welded providing superior weld quality compared with other welding processes, resulting in virtually no risk of leakage.

**ABB Power Factor controller**

The ABB RVC and RVT power factor controllers are available in the CapCube.

The RVC is a user-friendly controller which includes the essentials required for automatic power factor control.

The RVT offers a higher level of functionality including MOD-BUS communication, as well as monitoring and logging of network parameters.
Key components

Inrush reactors
Inrush reactors reduce the current surge when switching capacitor stages in parallel, as defined by international standards. These inrush reactors are aluminum wound and resin encapsulated.

ABB HRC fuses
The HRC (high rupturing capacity) fuse links are used to protect capacitor banks and associated equipment against short-circuits. They protect against thermal and electromagnetic effects of heavy short-circuit currents by limiting the peak current values and interrupting the currents in several milliseconds.

ABB VSC-S contactors
ABB contactors are designed and type tested for heavy duty capacitor switching.

The medium voltage VSC series of contactors are suitable for operating in AC systems and builds on ABB's experience in over 20 years of vacuum technology.
### Technical data

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CapCube is designed according to IEC standards.
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