



FEBRUARY 2017

Capacitors and Filters

Ensuring stronger, smarter and greener power networks

Power Quality offering from ABB

Defining power quality

Definition

A quantifiable measure signifying availability, quality and efficiency of the power being utilized and supplied

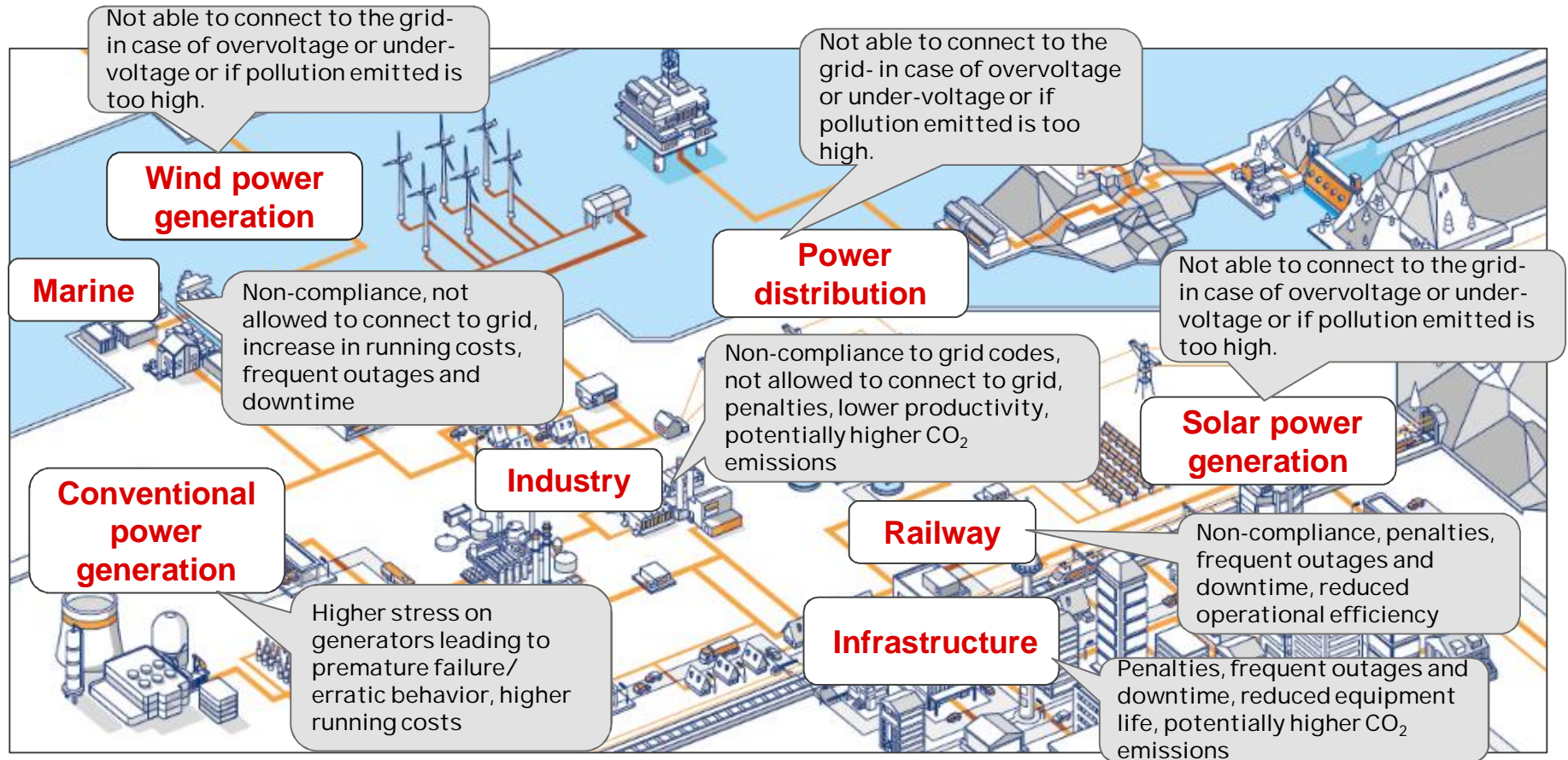
Benefits include:

- Supply network reliability and availability
- Energy efficiency
- Industrial productivity
- Eco-efficiency/ lower environment impact



Power Quality offering from ABB

Consequences of poor power quality



Power Quality offering from ABB

Value proposition: Ensuring stronger, smarter, greener grids



Stronger
Enhancing grid / power network reliability

Industrial productivity
– Increase in plant capacity due to reduced equipment failure and downtime

Smarter
Efficient power for a sustainable world

Industrial productivity
– Increased network reliability and energy efficiency

Greener
Energy efficiency
– Due to lower network losses

Eco-efficiency
– Due to lower carbon emissions

Improved power quality leads to stronger, smarter and greener power networks for power generation, transmission, distribution, industries and infrastructure projects

Reasons for investing in Power Quality

Poor Power Quality costs

Sector	Financial loss per incident
Semi-conductors production(*)	3 800 000 €
Financial trade(*)	6 000 000 € per hour
Computer center(*)	750 000 €
Telecommunication(*)	30 000 € per minute
Steel industry(*)	350 000 €
Glass industry(*)	250 000 €
Offshore platforms	250 000 € per day
Dredging/land reclamation	50 000 – 250 000 € per day



Poor Power Quality:

- Reactive power
- Harmonics
- Load imbalance

That ultimately results in down-time and high running costs

Reasons for investing in Power Quality

Examples of impact of harmonics

	Losses/ year	CO ₂ emissions/year
Small/medium transformers	3000 €	30 T
Large transformers	10 000 €	100 T
LV cables (per 100 m)	1500 €	15 T
Motors	10% additional losses	10% additional emissions



Capacitors and Filters

Our vision and mission

Vision

Be recognized as the leading supplier of power quality solutions, focusing on filtering and reactive power compensation




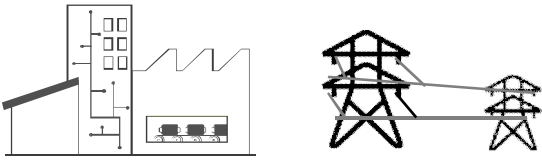


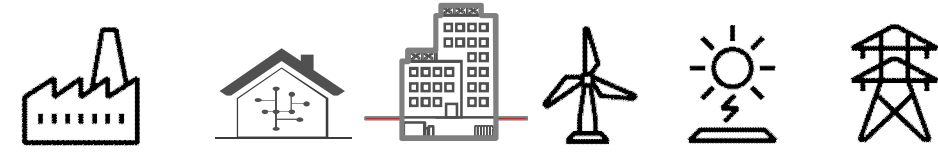





Mission

Provide value to customers by presenting them with the right power quality solutions and products for their applications



Capacitors and Filters

Addressing Power Quality for all voltage levels and segments

220- 800 kV		 
40- 130 kV		 
12- 36 kV		 
0.2- 1 kV		 

Capacitors and Filters

Presence across industry verticals



Capacitors and filters products from ABB can be found across geographies and industry verticals, across the power value chain for low, medium and high-voltage applications - helping shape a stronger, smarter and greener grid.

Capacitors and Filters

Presence across industry verticals: Aluminium

Sohar Aluminium Company

Country: Oman

Company profile:

- One of the world's largest aluminium smelter facilities
- Produces 390,000 tons of aluminium annually

Customer issue:

- High level of harmonics due to the smelting process
- Compliance issue- unable to connect to the grid.

Power quality solution from ABB: Four harmonic filter banks at 55 MVAR



Capacitors and Filters

Presence across industry verticals: Automotive

Toyota Indus Motors

Country: Pakistan

Customer issue:

- High level of reactive and unbalanced loads due to welding process
- High penalties

Power quality solution from ABB: Dynamic reactive power compensator PQC-STATCON

Result: Power factor improvement to 0.95



Capacitors and Filters

Presence across industry verticals: Automotive

BMW MINI

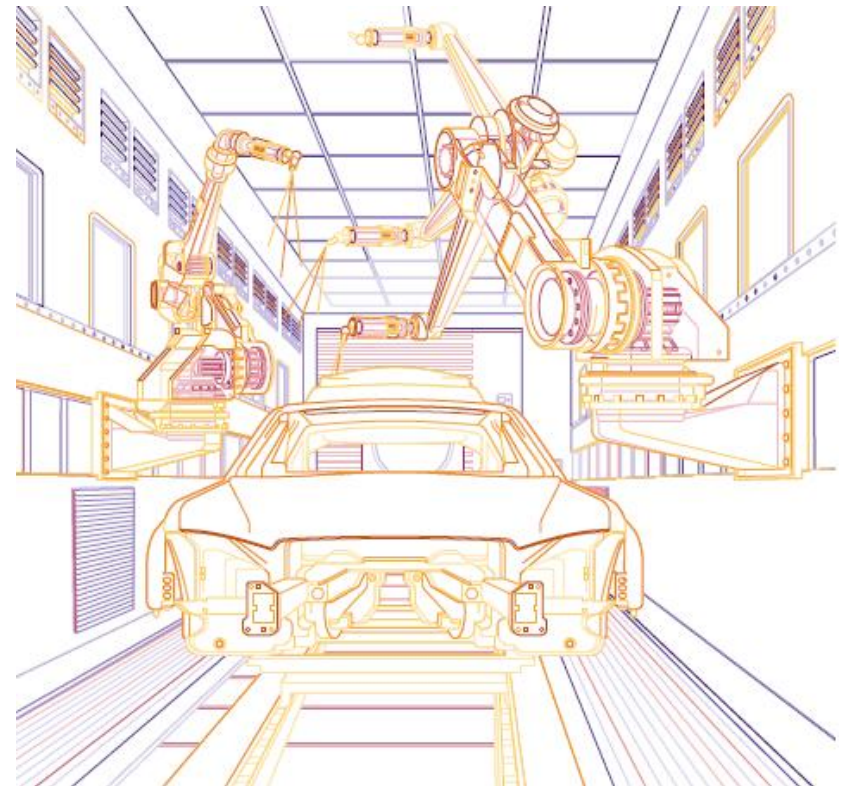
Country: Great Britain

Customer issue:

- High level of harmonics
- Power quality solution from ABB: PQFM active filter technology

Other projects:

- Bridgestone, Brazil
- Fiat, India



Capacitors and Filters

Presence across industry verticals: Buildings

Accenture

Country: India

Company profile: Global management consulting, technology services and outsourcing company

Customer issue:

- Tripping of UPS due to high level of harmonic distortion.

Power quality solution from ABB: 7 PQF Active filters



Capacitors and Filters

Presence across industry verticals: Buildings

Burj Khalifa

Country: UAE

Company profile: Tallest structure in the world, standing at 829.8 m

Customer issue:

- Harmonic pollution

Power quality solution from ABB: 15 PQFI - 2 PQFM and 96 PQFS active filter



Capacitors and Filters

Presence across industry verticals: Chemical

DOW Chemical Company

Country: USA

Customer profile: one of the largest single plant industrial complexes in the world

Customer issue:

- Harmonic pollution
- Voltage support to new loads

Power quality solution from ABB: 2 sets of harmonic filters



Capacitors and Filters

Presence across industry verticals: Food and Beverage

PepsiCo India

Country: India

Customer profile: Well recognized global player in beverages and snacks

Customer issue:

- Poor power factor
- Penalties from local utility

Power quality solution from ABB: PQC-STATCON

Result:

- Power factor improved to unity
- Savings of 5 to 10 percent in annual electricity charge



Capacitors and Filters

Presence across industry verticals: Food and Beverage

McCain

Country: Great Britain

Customer issue:

More efficient use of existing power network to avoid a major investment in new power infrastructure

Power quality solution from ABB: power factor correction equipment

Result:

Savings: £100K of investment of new supply



Capacitors and Filters

Presence across industry verticals: Healthcare

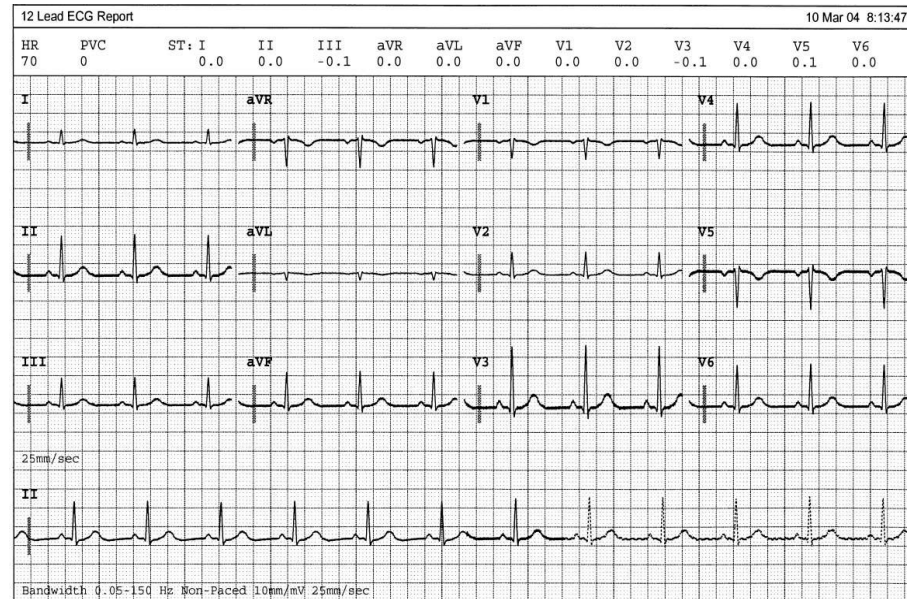
Royal Melbourne Hospital

Country: Australia

Customer issue:

- Harmonic distortion disturbing electrocardiograph equipment

Power quality solution from ABB: PQFI active filter



Capacitors and Filters

Presence across industry verticals: Marine

Koja port

Country: Indonesia

Customer profile: The port hosts 450 ships annually and has a capacity of 1 million TEUs of containers per year

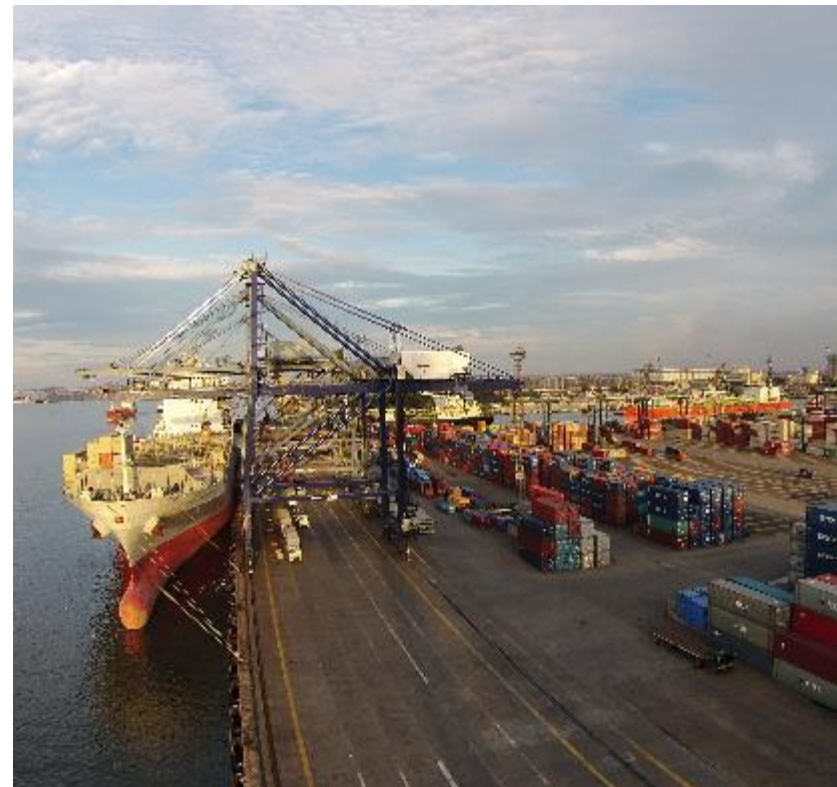
Customer issue:

- Penalties from local utility of up to \$50kUSD/month

Power quality solution from ABB: Dynacomp

Result:

- Power factor improvement
- Energy and cost savings



Capacitors and Filters

Presence across industry verticals: Marine

Jadrolinija

Country: Croatia

Customer issue:

- Harmonic issues creating intermittent problems

Power quality solution from ABB: PQFI active filter

Result: 10% of fuel savings as a generator was switched off



Capacitors and Filters

Presence across industry verticals: Metals

Tata Steel

Country: India

Company profile: Second largest steel company in India with an annual capacity of 9.7 million tons.

Project details:

- Study of the electrical network which included field measurements, system performance evaluations and simulations for various operating scenarios of the plant.
- Basis the results of the study, ABB recommended installation of harmonic filters at various buses



Capacitors and Filters

Presence across industry verticals: Mining

KSO Gold Mine

Country: Laos

Power quality solution from ABB: LV Active Filter

Other projects:
Country: Turkey

Customer profile: Biggest gold mine in Turkey

Power Quality solution from ABB: MECB (3 sets of ABBACUS, total 11MVar at 6.6kV)



Capacitors and Filters

Presence across industry verticals: Railway

Bulgarian Railways

Country: Bulgaria

Customer issue:

- Penalties from local utility

Power quality solution from ABB: PQC-STATCON



Capacitors and Filters

Presence across industry verticals: Recreational/ Cultural

Blackpool Pleasure Beach

Country: Great Britain

Customer issue:

- Very large demand on three-phase power supply
- Costly upgrade required without PFC correction

Power quality solution from ABB: 2 Capacitor banks of 900 kvar

Result:

- 25% power decrease
- Electricity savings: approx £2,000 per month



Capacitors and Filters

Presence across industry verticals: Solar

Asia Fab Tec Limited

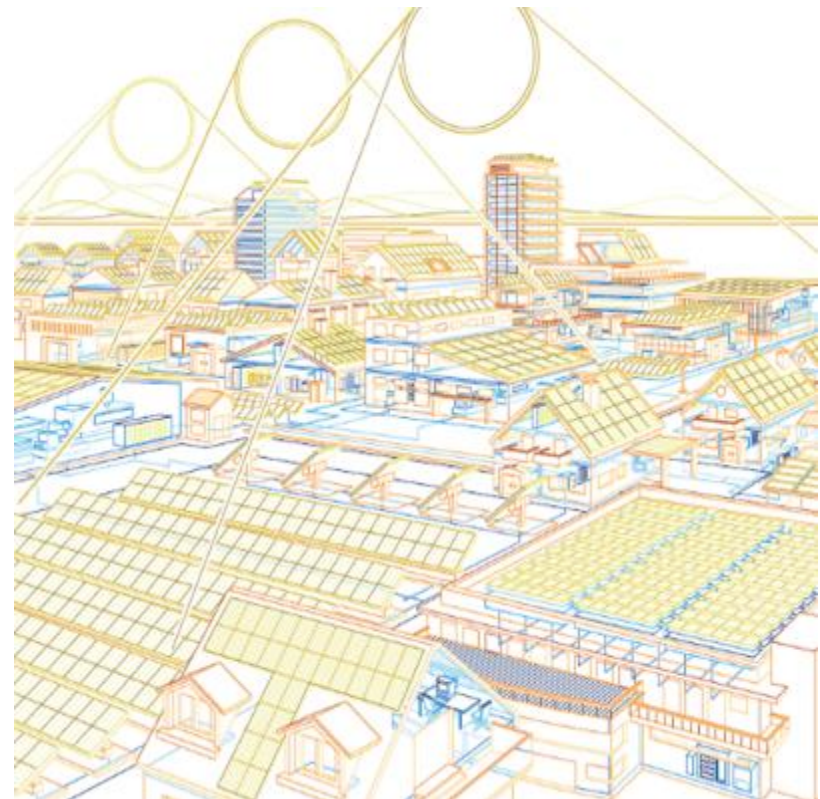
Country: India

Company profile: 18 MW Solar Power Plant at Tumkur, Karnataka

Customer issue:

- To meet the Dynamic reactive power capability at the plant incomer level

Power quality solution from ABB: PQC-STATCON



Capacitors and Filters

Presence across industry verticals: Utilities

RTE (Réseau de transport d'électricité)

Country: France

Customer issue:

- Stabilization of the French network
- Make the network more stress tolerant

Power quality solution from ABB: high pass filters solutions

Result:

- Lower content of Total Harmonic Distortion, THD
- Balance overload in French network



Capacitors and Filters

Presence across industry verticals: Wholesale and retail trade

Ikea

Country: Spain

Customer issue:

- Harmonic pollution

Power quality solution from ABB: PQFM active filters

Result:

- Air conditioning systems working properly
- Reduction in failure of electronic equipment
- Voltage stability



Capacitors and Filters

Presence across industry verticals: Wind

Hogager Park

Country: Denmark

Company profile: Windfarm

Customer issue:

- VAR support

Power quality solution from ABB: MV ABBACUS



Capacitors and Filters

Battery energy system

Nordhavn Denmark

Complete battery system for storage of renewable energy from a residential harbour district

Connected to Nordhavn's electricity grid to supply 60 households with electricity for up to 24 hours

Urban laboratory for energy solutions




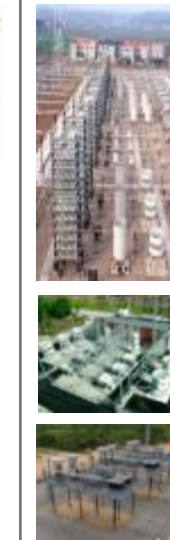


Solution: ABB's ESI Inverters

- Output: 630 kW
- Energy: 460 kWh
- Technology: Li-ion
- Commissioning: January 2017



Capacitors and Filters offering from ABB

Wide range of products

Capacitor units for MV and HV	MV/HV shunt banks-open type	MV shunt banks-metal enclosed	Capacitor solutions in HVDC and FACTS	Capacitor units and banks for LV	LV dynamic compensation	LV active filters	Capacitor accessories
						  	

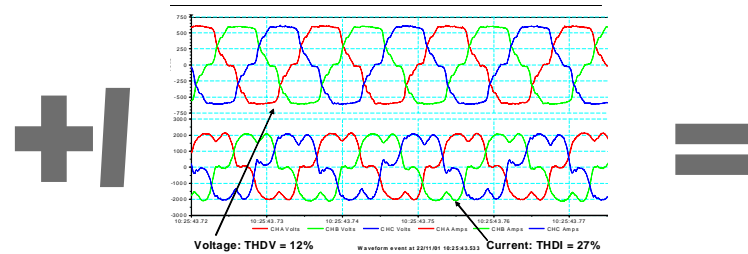
Capacitors and Filters offering from ABB

Offering what the customers need

Measurement



Analysis



Solution



Products



Service

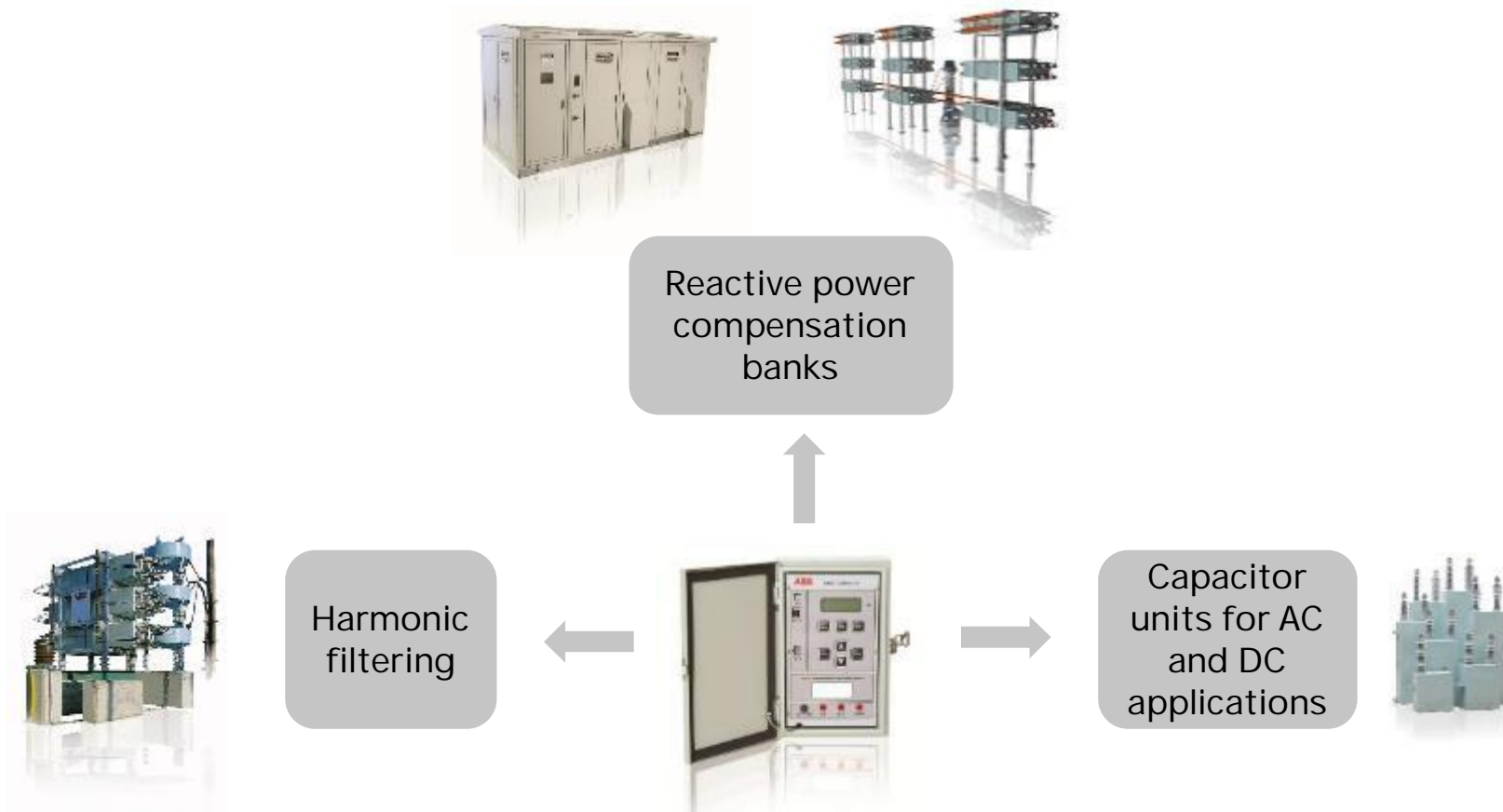


Training



Capacitors and Filters offering from ABB

MV/HV portfolio and applications



Capacitors and Filters offering from ABB

MV/ HV reactive power compensation components

Capacitor Units

In-house design and production of a large variety of MV/ HV capacitor units (single-phase, split-phase, three-phase, surge capacitors, DC applications)

Benefits

- High reliability
- All types of fuse technologies available (internally, externally and fuse-less)
- Low dielectric losses
- Low installation and maintenance costs
- Units for AC and DC applications (e.g. HVDC projects)
- Dry DC technology available

Applications : all types of power grid applications and industrial installations where compensation, surge protection or DC capacitors are required



Capacitors and Filters offering from ABB

MV/ HV reactive power compensation components

Motor surge protection

Protection against insulation failure
High transient overvoltage withstand
Low operating losses
Long lifetime
Compact modular enclosure

Applications:

- High voltage motors and generators
- Dry-type transformers
- Motor control centers
- Medium-voltage switchgear



Capacitors and Filters offering from ABB

MV/ HV reactive power compensation components

Metal enclosed capacitor banks

Fully integrated solution for reactive compensation

Benefits

- Fixed and switched solutions available
- Range of enclosure types to suit a variety of applications (up to 36kV, indoor/ outdoor)
- Protected live parts
- Modular design fully expandable
- Can be moved as plant demands change
- Filtering solutions available

Applications: electrical distribution, utilities, industrial users, renewable segment

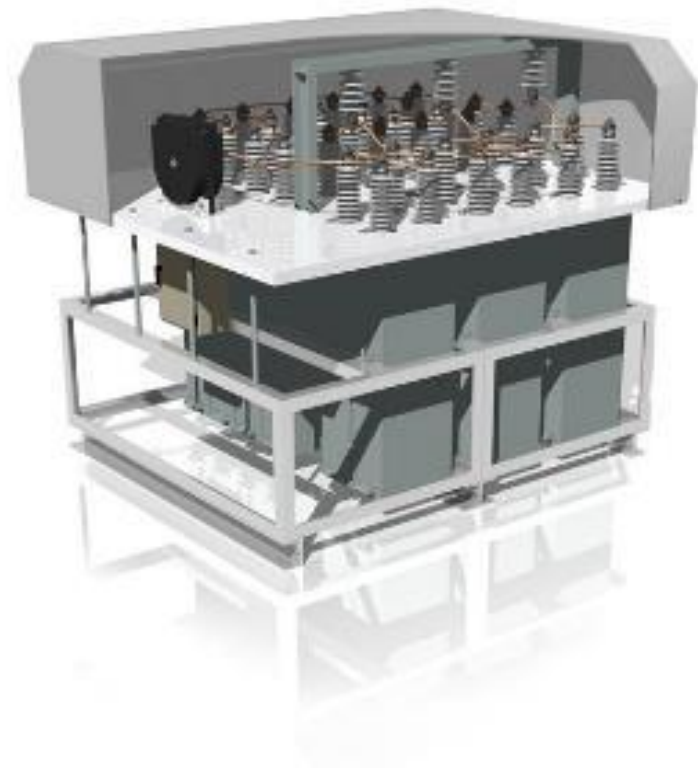


Capacitors and Filters offering from ABB

MV/ HV reactive power compensation components

Metal enclosed capacitor bank SIKAP

- Fully insulated and fixed reactive power compensation system
- Compact aluminum enclosure that covers all live parts
- ABB impregnated capacitors with long service life time and low losses
- Fixed compensation in a wide range of installations, covering climate conditions between from -40°C to +40°C



Capacitors and Filters offering from ABB

MV/ HV reactive power compensation components

Pole mounted and pad mounted capacitor banks

Economical solutions for shunt reactive compensation on overhead distribution networks

Benefits

- Fixed or switched system available
- Galvanized steel or aluminium frame suitable for pole mounting
- Increased safety and reliability thanks to bird guards

Applications

- Voltage stability
- Reactive power compensation
- Volt-var management



Capacitors and Filters offering from ABB

MV/ HV reactive power compensation components

Power factor correction solution CapCube

- Ideal for medium voltage motor control center(MCC) applications or any inrush PFC applications up to 12 k
- Integrates an inrush PFC capacitor bank of up to 1 Mvar within a conventional UniSafe switchgear platform
- User-friendly power factor controller
- Designed for heavy-duty operation
- Protection against short circuits



Capacitors and Filters offering from ABB

MV/ HV reactive power compensation components

Open rack capacitor banks

Reactive power compensation in all types of power grids

Benefits

- Reliable operation in all climates
- Cost effective designs
- Environmentally friendly
- Compact design
- Easy to install and maintain
- Optimal solution for each installation

Applications

- Small and large utility and industrial installations where reactive power compensation is required



Capacitors and Filters offering from ABB

MV/ HV reactive power compensation components

Open rack filter banks

Open-rack passive filtering solution for addressing harmonic problems in HV and MV networks

Benefits

- ABB expertise to measure and analyse the harmonic content
- Suggestion of the most efficient solution/design to reduce harmonics
- Complete package
- Reliable operation in all climates

Applications

- Small and large MV and HV applications

Note: MV enclosed solutions ABBACUS can also be obtained with filtering functionality



Capacitors and Filters offering from ABB

MV/ HV reactive power compensation components

Modular capacitor banks

- Fast deployment of capacitor compensation (minimal field installation and commissioning work)
- Easy to relocate reactive power compensation solution
- Many standardized configurations
- Available as a stand-alone unit or for integration into pre-existing substation
- Easy to relocate
- Integrated package for single point responsibility



Capacitors and Filters offering from ABB

Dry DC capacitor for Voltage Source Converters

DryDCap

Key component for HVDC- and SVC-light (or equivalent)

Dry DC capacitor for modern multilevel converter topologies

High energy density

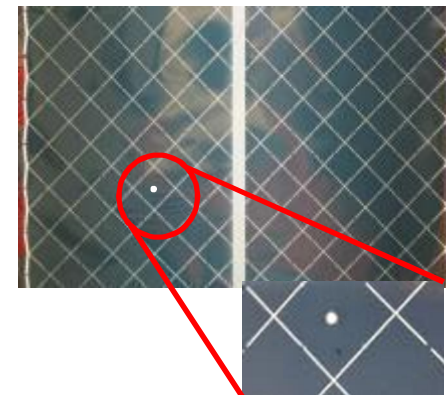
High voltage withstand

High current stress

Environmentally friendly as dry concept

Embedded safety because of

- Metallized dielectric electrode leading to self-healing process
- Segmented electrode ensuring a safe end of life



Capacitors and Filters offering from ABB

Accessories

Capacitor controller type CQ

Application: Reliable and versatile method to switch pole-mounted capacitors

Benefits

- Large variety of control methods available (power factor, voltage, temperature control)
- Large number of communication possibilities
- Available also for three-phase monitoring
- Accurate sampling, measurement & decision making thanks to fast onboard micro-processor
- Advance automatic switching (single-phase/three-phase)
- Flexible mounting options
- Fully user programmable
- Real-time monitoring



Note: for standard power factor control applications the RVC and RVT controllers can also be used

Capacitors and Filters offering from ABB

Accessories

Capacitor Vacuum Switches PS

Vacuum interrupters especially designed for capacitor switching applications

Benefits

- Single and three phase versions available
- Voltage range up to 38 kV
- Compliant to highest restrike category in accordance to IEEE 37.66 (class A)
- Over 50,000 paired fault-free mechanical operations
- Operable with most capacitor controllers
- Light weight and compact design
- Maintenance free

Applications: capacitor switching applications (metal enclosed capacitor banks, outdoor rack banks or pole mount banks)



Capacitors and Filters offering from ABB

Accessories

Capacitor measurement tool CB2000

Portable capacitance meter

Benefits

- No disconnection of the capacitor banks
- Ergonomic and compact design
- Low weight
- Own battery system
- LDC display
- Easy transfer of values to a PC via USB
- Short-circuit proof
- Measuring range: 0 - 1000 μ F

Applications: measurement of MV and HV capacitor units and capacitor banks



Capacitors and Filters offering from ABB

Accessories

Noise reduction

- Noise damper, cap or cover to reduce noise in new capacitor installations or for retrofit applications
- Three methods to fit the customer needs
- Compliance with specific noise restrictions
- Used for oil impregnated power capacitors
- For new bank deliveries or as retrofit products
- From moderate to high level of sound attenuation



Capacitors and Filters offering from ABB

Compensation and filter solutions for all applications

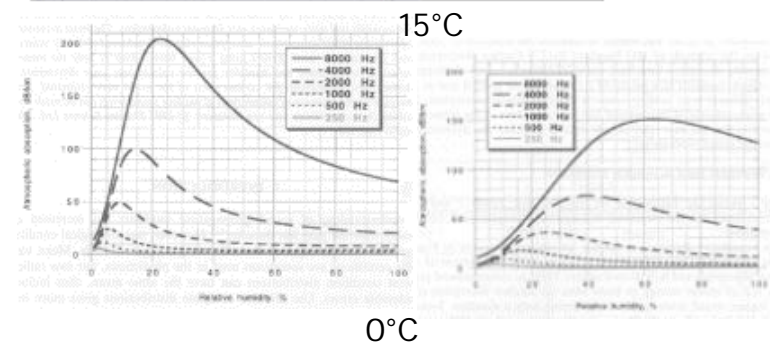
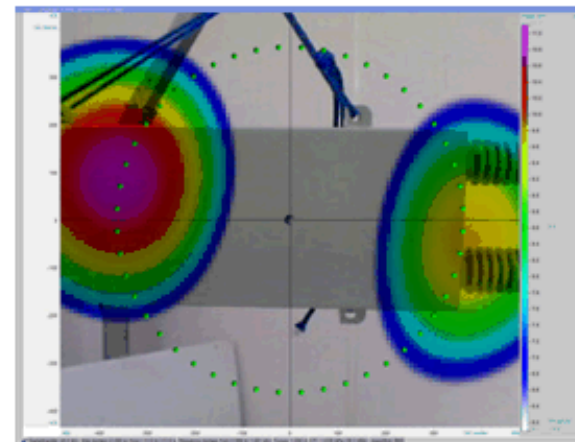
Reduced noise levels: We can meet high demands on low acoustic noise

ABB has patented solutions for low noise generation in MV and HV compensation solutions

Mechanical resonance in capacitor units is eliminated

Examples of installations with high demands on low acoustic noise

- Sweden-Poland, HVDC, 11/13/24:th harmonic filter
- Italy-Greece, HVDC, 12/24:th harmonic filter
- Essent, Netherlands, Shunt compensation, 8x48 Mvar, 180 kV
- StoreBælt, HVDC Denmark
- Fenno-Skan 2, HVDC Finland



Capacitors and Filters offering from ABB

Capacitors for HVDC and FACTS

ABB capacitors and filters are being used in the most demanding applications

- Negligible losses and high reliability
- Excellent electrical properties
- Surface-treated high-quality steel for container
- Highest quality and reliability for the bushings and terminals
- Designed as per customer specifications

HVDC applications



AC filters

DC filters

Series Compensation applications



Capacitors and Filters offering from ABB

Compensation and filter solutions for all applications

Volt-Var optimization solutions

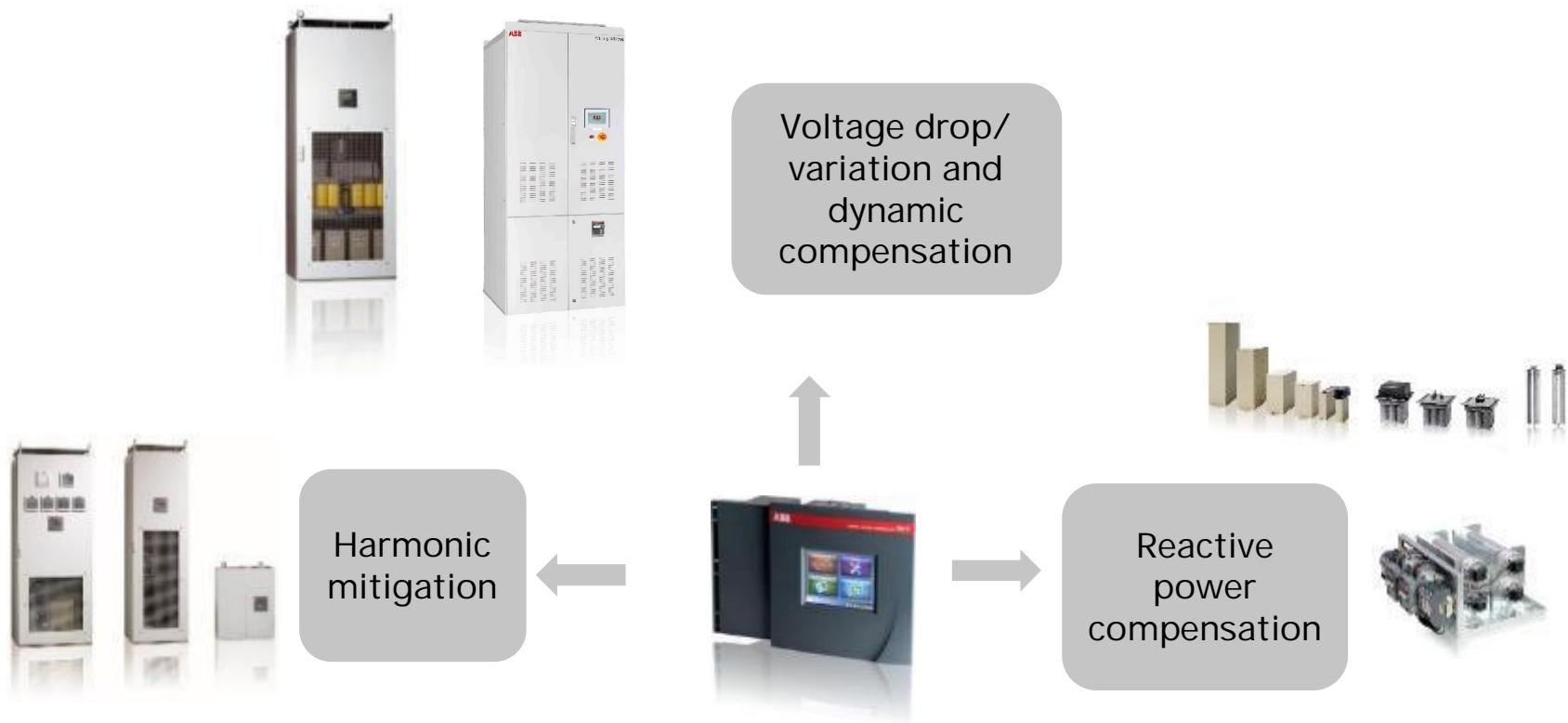
VVMS software allowing to control tens-of-thousands of switched capacitors for distribution var and voltage optimization
Can be combined with ABB pole mounted capacitors

Allows to make better and more efficient use of existing infrastructure



Capacitors and Filters offering from ABB

LV portfolio and applications



Capacitors and Filters offering from ABB

LV reactive power compensation components

Capacitor units CLMD

Best solution for low power factor compensation

Benefits

- High reliability and flexibility
- Dry type design*
- Unique sequential protection system
- ABB in-house metalized film

Applications: compensation in industrial and commercial networks

* Depending on market needs wet type designs also available



Capacitors and Filters offering from ABB

LV reactive power compensation components

Capacitor units QCap

- Complements the existing capacitor portfolio (from 2.5 to 30 kvar)
- Dry type design
- ABB capacitor technology
- Low losses
- In-house metallization giving excellent dielectric properties
- Long life time thanks to first class capacitor film
- Reliable: optimized thermal dissipation
- Safety: sealing and overpressure disconnection system



Capacitors and Filters offering from ABB

LV reactive power compensation components

Capacitor shelves

- Single pre-wired sub-assembly combining capacitor units, contactors and fuses
- Enable panel builders to incorporate the power factor correction technology within their own low voltage panels
- Composite solution to switchboard power factor correction requirements
- Easy to install
- Compact arrangement
- Reliable fully rated system



Capacitors and Filters offering from ABB

LV reactive power compensation components

Power factor controllers type RVC and RVT

A key player in the control and monitoring of power quality

Benefits

- Measurement and display of key parameters (single-phase and three-phase versions available)
- Easy to use thanks to user-friendly interface (touch screen on RVT)
- Easy commissioning
- Usable in LV and MV networks

Applications: control of power factor and measurements in industrial and commercial networks



Capacitors and Filters offering from ABB

LV reactive power compensation components

Standard capacitor banks- Contactor switched

The ideal automatic power factor correction solution for steady state or slowly varying loads requiring power factor compensation

Benefits

- Powerful and compact
- Easy to install and use thanks to the ABB controllers
- ABB capacitor technology
- Detuning reactors available
- Wall-mounted and free-standing floor mounted cubicles

Applications: industrial and commercial networks



Capacitors and Filters offering from ABB

LV reactive power compensation components

Thyristor switched reactive power compensators

Ultra-rapid transient-free stepped power factor compensation and voltage fluctuation mitigation

Benefits

- No switching transients thanks to thyristor switched technology suitably controlled
- ABB CLMD capacitor technology
- Can be connected up to 690V
- Modular and compact standardized design
- Easy to install and extend
- Advanced communication features with Modbus

Typical applications: fast and/or large varying loads, e.g. cranes, welders, offshore platforms, railway applications

Connection to MV networks through step-up transformer



Capacitors and Filters offering from ABB

LV reactive power compensation components

Stepless reactive power compensator- PQC-STATCON

Instantaneous stepless power electronics based dynamic compensator for reactive power and unbalanced loads

Benefits

- Transient-free and stepless reactive power compensation
- Stepless compensation of fast varying inductive and capacitive loads
- Load balancing functionality
- Improves the reliability of existing capacitor banks under dynamic conditions
- Reduces system losses and carbon footprint
- Reduces maintenance need and enhances life of electrical installations

Applications:

- Railway application, car manufacturing line applications, paper/ steel rolling mills
- Connection to MV networks through step-up transformer



Capacitors and Filters offering from ABB

LV reactive power compensation components

Active harmonic filter PQF

Ultimate answer to tough Power Quality problems caused by harmonics, load unbalance and reactive power demand

Benefits

- Unprecedented filtering efficiency thanks to closed loop control system
- Individual harmonic selection
- Stepless reactive power compensation
- Load balancing in 3 and 4-wire systems
- Full redundancy

Applications

- Small, medium or large applications
- Safeguarding Power Quality in industrial and commercial installations



Capacitors and Filters offering from ABB

LV reactive power compensation components

Energy storage inverter ESI

Energy storage inverter including harmonic mitigation, load balancing and reactive power compensation features

Benefits

- Suitable for a wide range of batteries
- Power quality functionalities
- Flexible communication platform
- Compact design

Applications

- For all energy storage systems
- Voltage and frequency stabilization
- To minimize the impact of renewables on the network
- For peak demand shaving



Capacitors and Filters

Conclusion

- ABB has a vast experience in evaluating and addressing Power Quality issues
- ABB can provide the best possible Power Quality solutions for your installations to make them reliable, long-lasting, energy efficient and environmentally sound
- Together we can improve the quality of your installations

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ABB