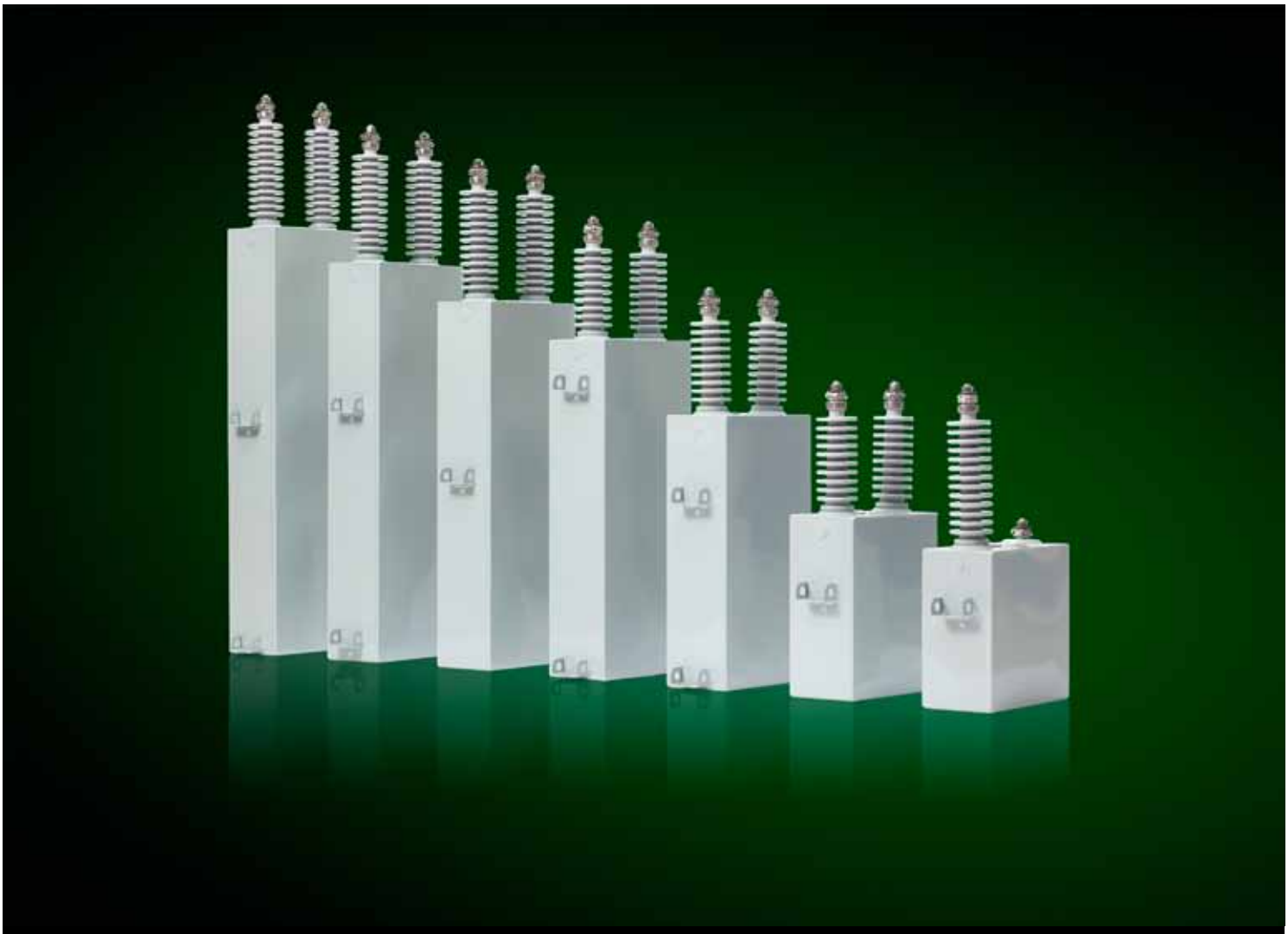


Power Capacitor Units for improved power quality

Power and productivity for a better world™

Applications for capacitors
Reactive power compensation

Most of the apparatus and loads connected to the electrical power system consume both active and reactive (inductive) power. Some examples of such components are transformers, transmission and distribution lines, induction motors, rectifiers, induction furnaces, etc. The most economical method of reducing reactive power consumption in electrical power systems is by installing capacitor banks. This method is called reactive power compensation.

The capacitor injects reactive power into the system, thus reducing the load in the entire transmission and distribution system. The advantage of reactive power compensation was realized early and today, most power utilities as well as large consumers of electrical power are installing capacitor banks in their systems.

420 kV capacitor bank installation in Norway.

Premium quality

ABB capacitors are produced in highly automated workshops, but it is the commitment of our employees that is the determining factor in attaining final results. A finely tuned quality system with constant checks during all phases of production guarantees high and consistent quality of the capacitor.

ABB has a solid reputation as a supplier of high quality products. Our capacitor plants, with their skilled and dedicated staff, is one of the most important reasons for this. Proper technical design, strict material requirements and highly automated production are important cornerstones of our operations.

Production controlled by well-established quality routines

Production is entirely customer-driven and each capacitor is individually monitored through the process using a computerized production follow-up system that enables full traceability. So as to be able to identify any deviations from the specified values at an early stage, verification measurements are made after several of the process steps. Each capacitor undergoes final testing to ensure quality.

Environmental matters play a central role in our operations

ABB capacitor plants are committed to ABB's general environmental policy with respect to sustainable development and low environmental impact. For all new and further development, substantial emphasis is placed on recyclability, production with low environmental impact and minimizing environmental impact during the active period of use.

Certification

Production is quality certified according to ISO 9001, environmentally certified according to ISO 14001 and occupational health and safety certified according to OHSAS 18001.

Testing resources close by

Test can be conducted in the laboratories in compliance with the requirements stipulated in the international standards IEEE and IEC. Special tests in accordance with our customer's specifications can also be conducted.

ABB also has facilities for carrying out development tests. With these testing resources, we are at the forefront in developing safe and reliable new-generation products.

The routine tests are part of the process of producing capacitor units and are always performed with the same test procedures, irrespective of whether or not the tests are witnessed by the client's representative.

Fusing technologies

Impregnated capacitor unit — CHD

The CHD type is a single-phase power capacitor of the all-film type, with low dielectric losses and long service life. The capacitors are impregnated with Faradol, a bio-degradable product with high insulation strength. The edges of the electrode foils are folded, enabling higher electrical stress. The ABB capacitor units have an extremely low failure rate and high reliability.

The CHD capacitor unit is made up of a number of elements, each consisting of very thin layers of dielectric materials and thin foils of aluminum as electrodes. The elements are stacked inside the capacitor container and connected in series and parallel to accommodate the voltage and capacitance ratings specified for the entire capacitor unit. The dielectric is undoubtedly the most influential factor for the reliability of the entire capacitor or capacitor bank. However, this is very dependent on the fuse technology and the unbalance protection arrangements.

Different fuse technologies

ABB capacitor units are available with all types of fuse technologies – internal fuses, external fuses or fuseless.

ABB can offer all those technologies. To limit failures related to electrical failures inside the capacitor unit, the capacitor can be equipped with fuses. The earliest type was the externally fused capacitor, with the fuse (of expulsion type) installed on the line, between the line and the capacitor. ABB later developed the internally fused technology CHDB, with each element inside the capacitor equipped with a fuse. Beside this, there is an option of using fuseless capacitors type CHDF and the original externally fused, CHDE.

Internally fused concept, type CHDB

When it comes to internally fused capacitors, we are recognized as the world leader with over 50 years of experience. The internal fuses are current-limiting fuses. One fuse is connected in series with each element within the capacitor unit. They are designed and coordinated to isolate internal faults at the element level and allow continued operation of the remaining elements of that capacitor unit. This results in a very small part of the capacitor being disconnected, with the capacitor unit and the bank remaining in service. The fundamental concept is that by dividing a large system into small, individually protected elements, overall reliability is greatly enhanced. Advantages include higher reliability, less space, lower installation and maintenance costs and fewer live parts.

Externally fused concept, type CHDE

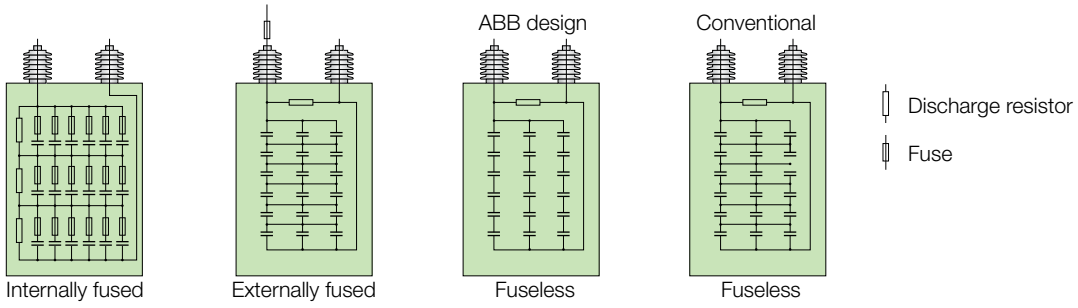
Each unit has its own fuse for disconnecting a failed capacitor unit from the bank. Once a capacitor unit is removed, an overvoltage on the remaining parallel capacitors results. This overvoltage must either be limited to a maximum value of 110% voltage or the bank must be tripped offline. The bank consists of many capacitor units connected in parallel. Concerns with excessive parallel energy and fuse limitations require the capacitors to be relatively small (average of 200 kvar). Although the external fuses provide a visual indication of a failure, banks tend to occupy more substation space, are more expensive, have many live parts subject to possible damage by animals and have higher installation and maintenance costs.

Fuseless concept – conventional CHDF

This concept was developed by ABB in the 1980s and is a result of the high reliability of today's all-film dielectric with capacitor case ruptures being a rare event. The internal design of fuseless capacitors (many elements in series) combined with the method by which the banks are connected (many "strings" of capacitor units in series), account for this design's excellent performance. A bank containing failed elements will operate continuously and withstand switching transients without rupturing the capacitor case. This is possible due to heavy duty welding of the two foil electrodes within the failed element, consequently diminishing the possibility of continued arcing.

Fuseless concept – internal strings, type CHDF

As an alternative to the conventional fuseless concept ABB, has developed a fuseless design based on a different internal connection of the element matrix. The elements are connected in parallel strings, which has the benefits of less capacitance deviation upon element failure, limitation of parallel energy inside the unit and that normal bank connection can be used. This technology does not restrict the capacitor unit size.



Product information
Capacitor unit

The ABB capacitor unit is designed for heavy duty operation in shunt, harmonic filter, series capacitor, SVC and HVDC applications in all climatic conditions.

Design features

- The single-phase power capacitor is a all-film type, with low dielectric losses and long service life. The capacitors are impregnated with a hydrocarbon fluid with high insulation strength.
- The edges of the electrode foils are folded, enabling higher electrical stress.
- The capacitor units have an extremely low failure rate and high reliability.
- The capacitor units are available with internal or external fuses or fuseless designs.
- The capacitor unit is made up of a number of elements, each consisting of very thin layers of dielectric materials and thin foils of aluminum as electrodes. The elements are stacked inside the capacitor container and connected in series and parallel to accommodate the voltage and capacitance ratings specified for the entire capacitor unit. The dielectric is certainly the most influential factor for the reliability of the entire capacitor or capacitor bank. However, this is very dependent on the fuse technology and the unbalance protection arrangements.

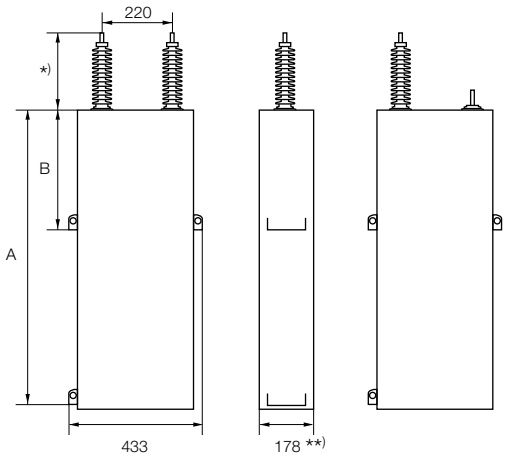
Dimensions and maximum power ratings

Size	A	B	Weight	Power	
				50 Hz	60 Hz
	mm	mm	kg	kvar	kvar
220	240	140	23	155	185
330	295	140	28	220	260
440	345	140	32	270	325
550	405	190	39	310	370
660	460	190	44	360	430
770	525	350	49	410	490
880	635	350	59	540	645
990	685	350	63	595	715
130	750	350	67	660	790
140	820	370	73	725	870
160	920	320	82	800	960
180	1030	430	90	900	1080
200	1140	535	100	1000	1200

**) The units can also be delivered in a 138 mm configuration (slim unit)

All dimensions in mm

*) 235 or 290 mm depending on bushings type BIL 75-95 or 125 kV



Technical data

Unit type	CHDB	CHDE	CHDF
Fusing type	Internally fused	Fuseless unit with all elements connected directly in parallel (often referred to as externally fused units)	Fuseless unit with separate parallel element strings
Power range [1]	300 - 1200 kvar	100 - 500 kvar	300 – 1200 kvar
Voltage range	1 – 14.4 kV	2.4 - 25 kV	12 – 25 kV
Frequency	50 or 60 Hz	50 or 60 Hz	50 or 60 Hz
Temperature range [2]	-50 to +55 °C	-50 to +55 °C	-50 to +55 °C
Dielectric material	Polypropylene film	Polypropylene film	Polypropylene film
Impregnant	Synthetic impregnation fluid, Faradol	Synthetic impregnation fluid, Faradol	Synthetic impregnation fluid, Faradol
Discharge resistor	Built-in type	Built-in type	Built-in type
Location	Indoor/outdoor	Indoor/outdoor	Indoor/outdoor
Capacitor container			
Material	Ferritic stainless steel	Ferritic stainless steel	Ferritic stainless steel
Thickness	1.5 mm	1.5 mm	1.5 mm
Surface treatment	Mineral-blasted surface Two layers of two-component paint	Mineral-blasted surface Two layers of two-component paint	Mineral-blasted surface Two layers of two-component paint
Color	Grey, Munsell 5BG 7/1	Grey, Munsell 5BG 7/1	Grey, Munsell 5BG 7/1
Fixing brackets	One or two per side	One or two per side	One or two per side
Terminations			
Bushings	Porcelain, one or two (standard grey color)	Porcelain, one or two (standard grey color)	Porcelain, one or two (standard grey color)
Terminals	M16 x 2.0	M16 x 2.0	M16 x 2.0
Clamps	Nickel-coated brass, max. 2 x 70 mm^2	Nickel-coated brass, max. 2 x 70 mm^2	Nickel-coated brass, max. 2 x 70 mm^2

1) Values applicable for 50 Hz
2) Non-standard temperature range can be quoted on request. Test report for temperatures -55 °C is available according to GOST standard.

Inquiry specification sheet
CHD units

Name of project

Position	#1	
Quantity		Nos.

General information

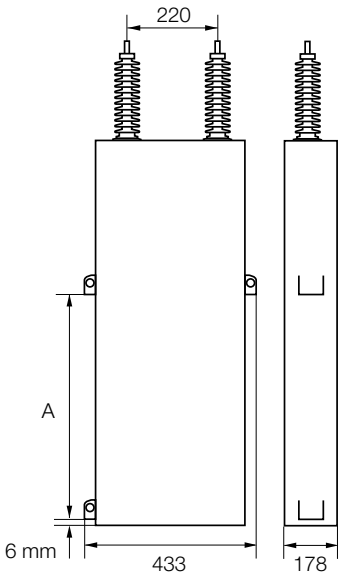
System voltage		kV
System frequency		Hz
Bank connection	Y, Y-Y, etc.	
Units in series/phase		Nos.
Units in parallel		Nos.

Other information

Language		
Documents	☐ English (default)	☐
Rating plate	☐ English (default)	☐
Accessories		
bird caps	☐ Yes	☐ No

For spares/replacement requirement

ABB order no.	
Unit serial no.	
Photo of the rating plate is required	



Technical information

Standard	☐ IEC 60871-1: 2005			
	☐ IEC 60871-2: 1999			
	☐ IEEE Std. 18: 2012			
Other standard	☐			
Temperature class				
Min temperature				°C
Max temperature				°C
Fusing type	☐ Internal			
	☐ External			
	☐ Fuseless			
Rated voltage				kV
Rated output				kvar
Rated capacitance				µF
Rated current				Amps
Discharge time/voltage				sec/V
Insulation level	☐ 75	☐ 95	☐ 125	kV
Bushing type [1]				
No. of bushings	☐ 1	☐ 2		Nos.
Color	☐ Grey (default)	☐ Brown		
Mounting brackets				
No. of brackets	☐ 2	☐ 3	☐ 4	Nos.
Upper bracket position [2]				mm
Pollution level (SCD) according to IEC 60815-1				
Light	☐ 16 mm/kV			
Medium	☐ 20 mm/kV			
Heavy	☐ 25 mm/kV			
Very heavy	☐ 31 mm/kV			

Special requirement

[1] ABB standard S-type bushings
[2] Distance from the base of can (capacitor unit container)

Testing equipment
Portable capacitance meter, CB-2000

The CB-2000 is an advanced measurement instrument characterized by its compact design and low weight, which makes it easy to carry when conducting measurements. No disconnections in the capacitor bank or mains connection are required. The collected measurement values can be easily transferred to a PC for storage and analysis. The stored values from the PC can just as easily be transferred to the meter so that they are available when new measurements are made.

Measuring capacitance is an important part of the regular maintenance of capacitor banks. With the CB-2000, even large capacitor banks can be measured quickly and easily because no internal disconnections are necessary within the capacitor bank. The CB-2000 is simple to use and easy to carry using the supplied shoulder strap. The measured values are clearly presented on the LCD display, which can be read both in daylight and in dark environments.

Measurement principle

The test signal is generated from the installed rechargeable battery pack or power adapter and connected to the measurement object with two voltage clips. The test voltage is 1.1–1.4 V. The test current is measured using a clip-on transformer that is easily positioned around the capacitor's bushing. For each measurement, the capacitance value, time and temperature are registered. The meter can handle data from five measurements per measurement object.

Analysis on PC

The CB-2000 is supplied with a program that enables the transfer of data to and from a PC via a USB cable. Prior to measurement, the CB-2000 can be prepared by uploading data from previously conducted measurements. After the measurements are made, the measurement values can be stored and analyzed on a PC. Measurement data is saved as tab-delimited text, which can be opened in Excel or similar spreadsheet program.

Support and downloads

Please visit www.abb.com/powercapacitors for more information and support. Here you can find can the user's guide in different languages and also download the latest software.

Measuring of capacitance in capacitor bank, Norway

Contact us

ABB AB
High Voltage Products

SE-771 80 Ludvika, Sweden
Phone: +46 (0)240 78 20 00
Fax: +46 (0)240 78 36 50

www.abb.com
www.abb.com/powercapacitors

NOTE: ABB AB is working continuously to improve its products. We therefore reserve the right to change designs, dimensions and data without prior notice.

Publication 1HSM 9543 31-03en, Edition 1, 2014-02, Power Capacitor Unit for improved power quality, Brochure, Photo: Hasse Eriksson

Power and productivity
for a better world™