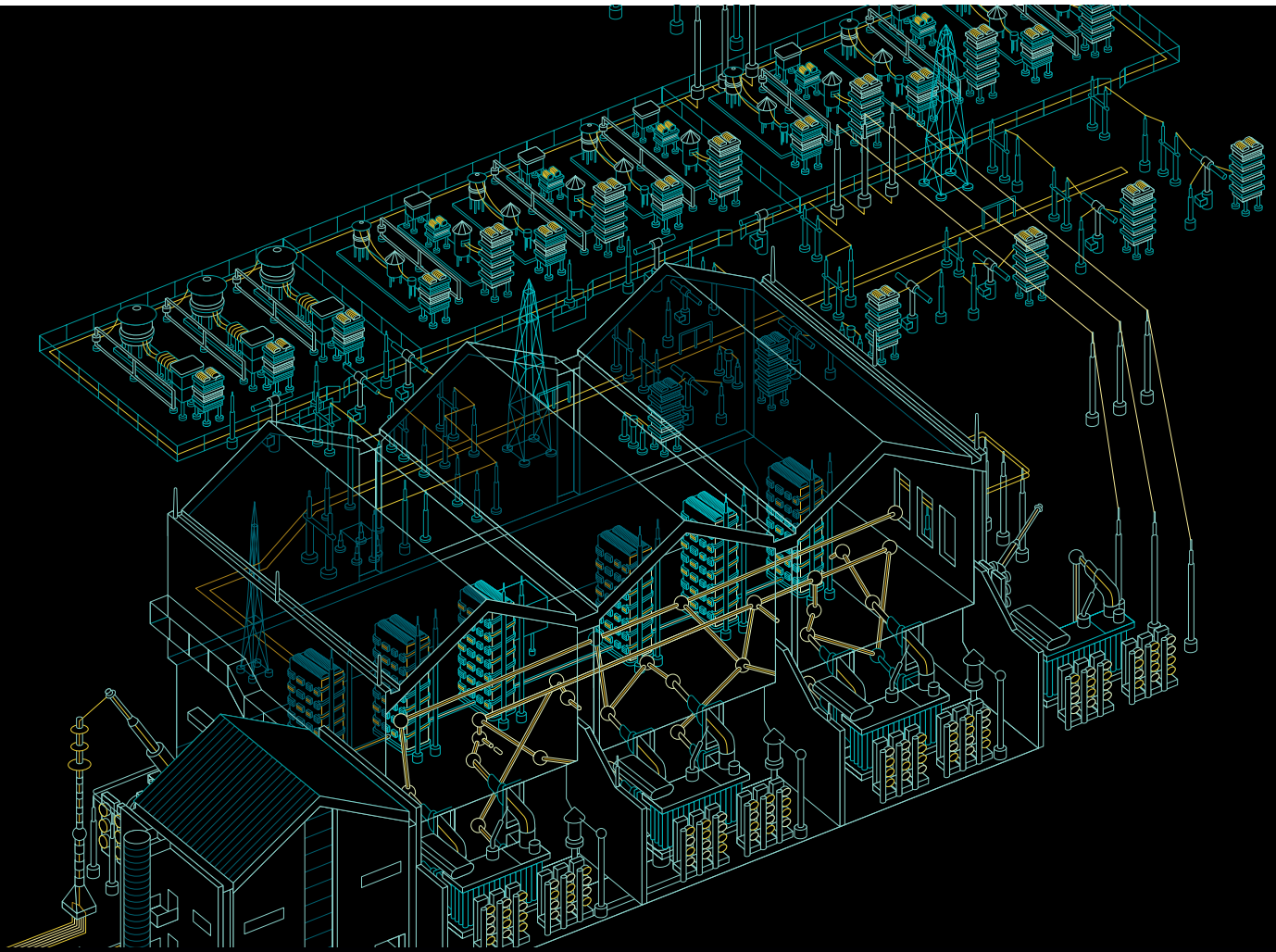




Power Solutions

ABB is a market leader in medium and low voltage applications

Power and productivity
for a better world™

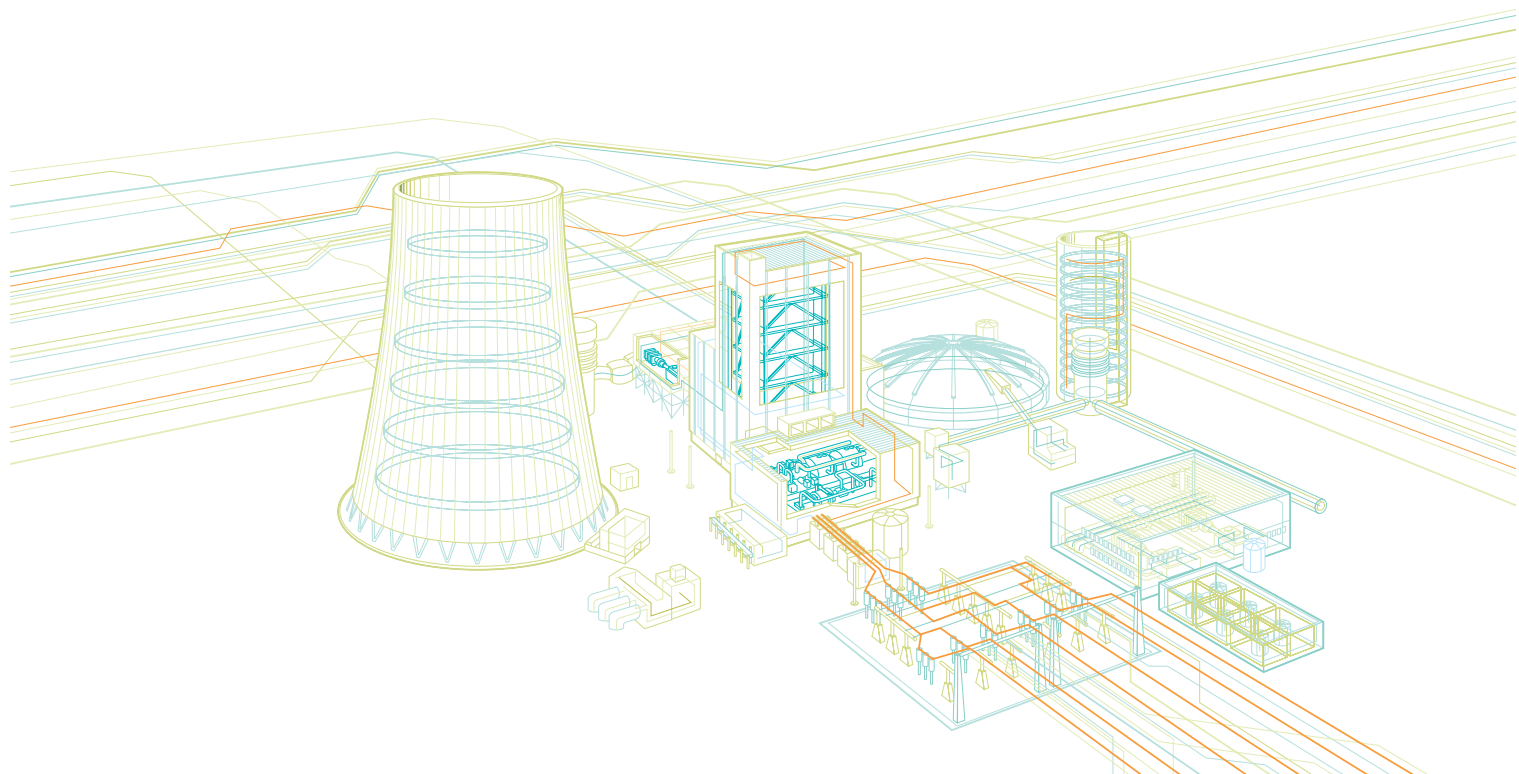


ABB power solutions

ABB is a market leader in Medium and Low Voltage applications. We offer one of the largest ranges of high quality products and systems available from any single supplier, backed up by in-depth application know-how. In putting together its portfolio ABB has taken care to address not only the core technology but also the systems and services that support customers across the total life cycle.

The ABB range covers the following products:

- HV Switchgear
- MV Switchgear
- Power Transformers
- Low Voltage Transformers
- Low Voltage Switchgear
- Air Circuit Breakers
- Moulded Case Circuit Breakers
- Miniature Circuit Breakers
- Power Factor Correction
- Motor Control
- Variable Speed Drives
- Soft Start Units
- Renewable Energy
- Service & Maintenance



MV Switchgear

UniGear type ZS1

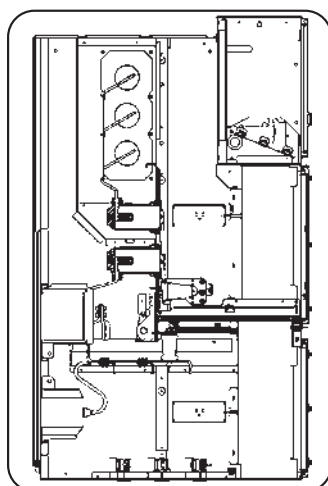
Air insulated metal-enclosed switchboards for primary distribution

- Internal arc proof construction
- Circuit-breaker racking-in/out with closed door
- Construction with pregalvanized sheet without welding points
- Wall standing solution
- Cable compartment accessible from the front
- Double level solution
- Slim fused vacuum contactor units

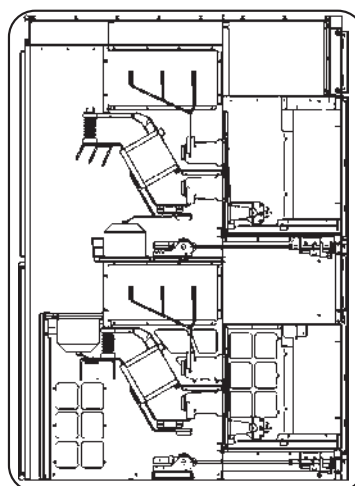


Technical Data				
Switchboard		UniGear 12	UniGear 17	UniGear 24
Type of construction		Metal-clad	Metal-clad	Metal-clad
Rated voltage	[kV]	12	17,5	24
Insulation levels	[kV]	12/28/75	17,5/38/95	24/50/125
Rated main busbar current (40°C)	[A]	... 4000	... 4000	... 2500
Rated branch connection current (40°C)	[A]	... 4000	... 4000	... 2500
Rated short-time current	[kA]	... 50	... 40	... 25
Arc proof withstand current	[kA]	... 50	... 40	... 25
Tested according to		IEC Standards	IEC Standards	IEC Standards
Overall dimensions of basic cubicle	H [mm]	2200/2675	2200/2675	2325/2775
	W [mm]	650/800/1000	650/800/1000	800/1000
	D [mm]	1340/1390	1340/1390	1560
Design includes:				
SF6 circuit-breakers		•	•	•
Vacuum circuit-breakers		•	•	•
Vacuum contactors		•	•	•
Integrated capacitor banks		•	•	•
Earthing switch		•	•	•
Bay computer		•	•	•
Measuring transformers		•	•	•
Measuring sensors		•	•	•
Technical catalogue	No.	649424	649424	649424

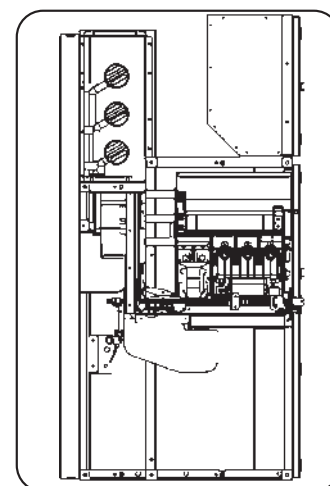
basic cubicle



Single level unit



Double level unit



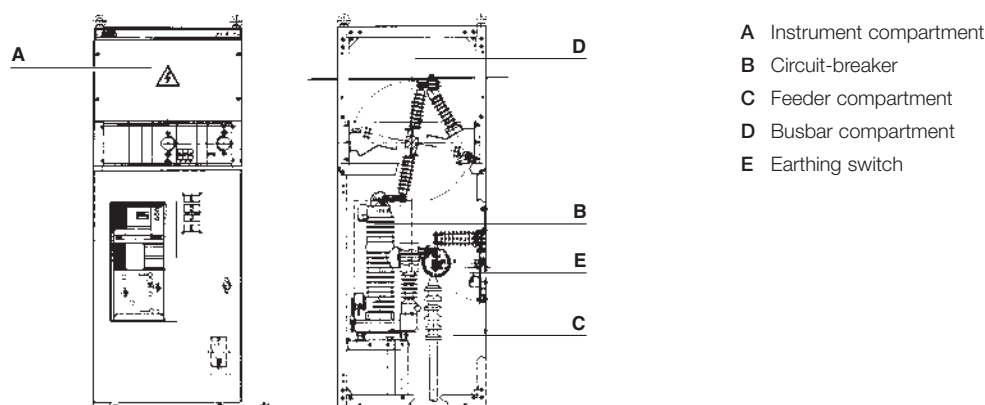
Slim fused vacuum contractor unit

UniAir – Air insulated metal-enclosed switchboards for secondary distribution

- Standard and arc-proof versions
- Complete air insulation of all live parts
- Circuit-breaker equipped with self-powered protection release
- Mechanical safety locks to prevent incorrect operations
- Software for switchboard design and estimates
- Wall standing solution
- Plug-in or withdrawable circuit-breakers
- Wide range of functional units
- Construction with pregalvanised sheet without welding points
- Wide use of recyclable material, production cycle certified ISO 14001

Technical Data		
Switchboard		UniAir
Type of construction	Metal-enclosed	•
Rated voltage	[kV]	24
Insulation levels	[kV]	24/50/125
Corrente nominale (40 °C)		
– Main busbars	[A]	400/630/800/1250
– Circuit-breakers	[A]	630/800/1250
– Switch-disconnectors	[A]	400-630
– Insulation isolators	[A]	400/630/800/1250
Rated short-time current		
– Circuit-breakers	[kA]	12,5 - 16 - 20 - 25 (25 kA a/at 12 kV)
– Switch-disconnectors	[kA]	12,5 - 16
– Insulation isolators	[kA]	12,5 - 16 - 20 - 25 (25 kA a/at 12 kV)
Arc proof withstand current	[kA]	16 - 0,5s / a richiesta: 16 - 1s – 25 x 0,5 s
Tested according to		IEC
Overall dimensions of basic cubicle	H [mm]	1950
	W [mm]	700/750
	D [mm]	1190/1290/1385
Design includes:		
SF6 circuit-breaker		•
Switch-disconnector		•
Disconnecter		•
Earthing switch		•
Bay computer		•
Measuring transformers		•
Technical catalogue	No.	649223

basic cubicle



Ring Main Units

Flexible

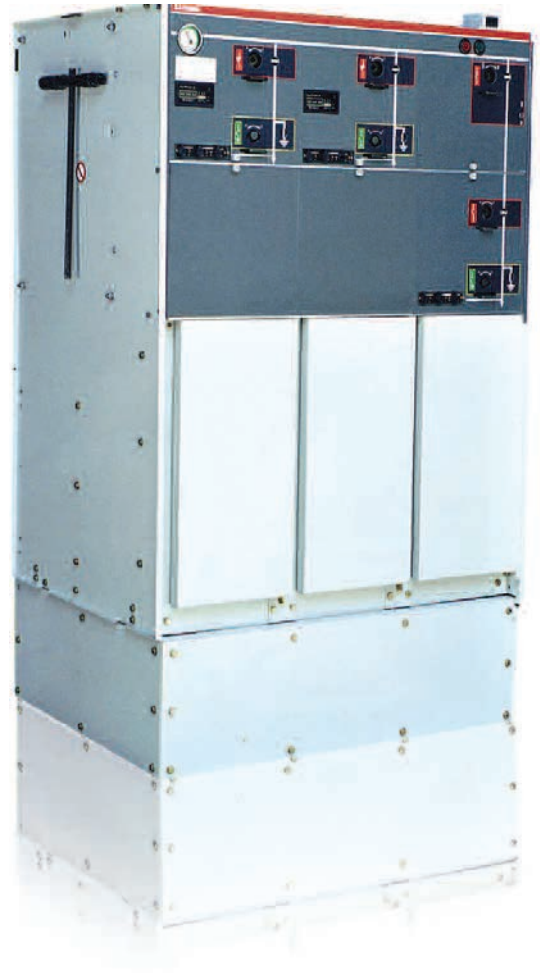
- Circuit breaker or fuse switch protection
- Integrated remote control and monitoring unit available

Economical

- Compact
- Maintenance free
- Standard design

Safe and environmental friendly

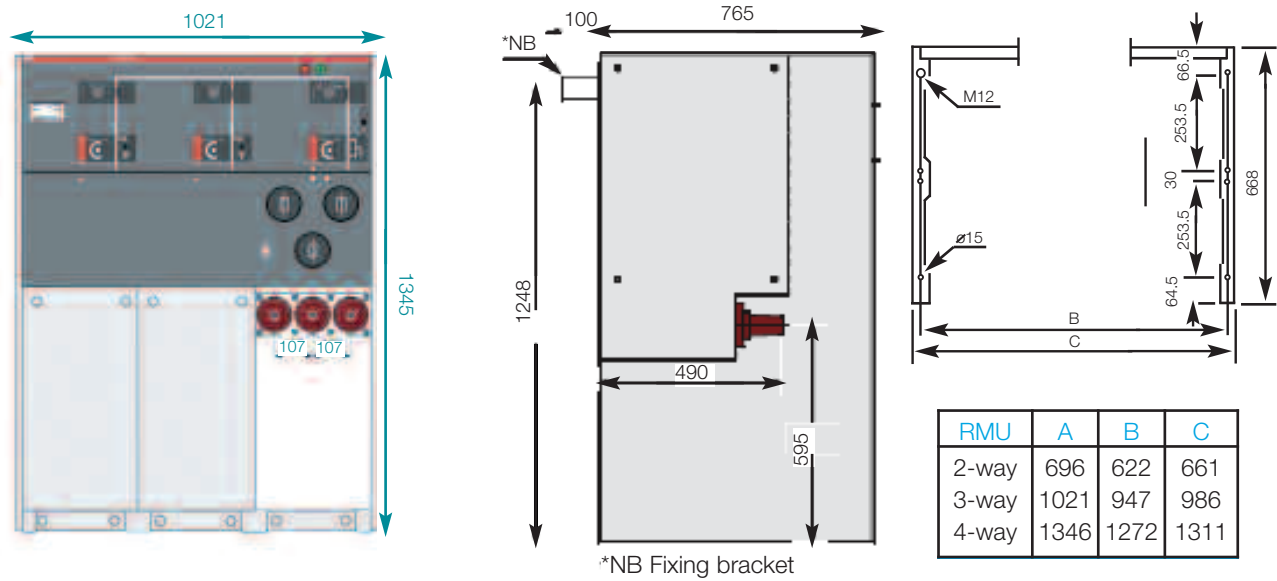
- Simple operation
- Arc suppressor available
- Recyclable
- Manufactured according to ISO 9001 and ISO 14001



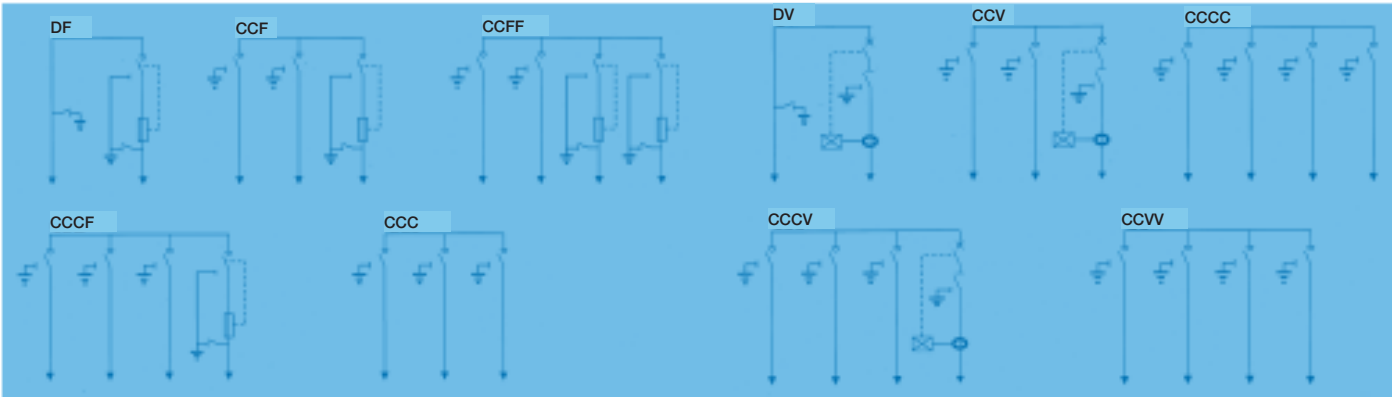
Technical specification		C - module switch disconnect	Earthing switch	F - module switch fuse switch	Downstream earthing breaker	V - module Vacuum circuit	Earthing switch
Rated voltage	kV	12/24	12/24	12/24	12/24	12/24	12/24
Power frequency withstand voltage	kV	28 ¹⁾ /50	28 ¹⁾ /50	28 ¹⁾ /50	28 ¹⁾ /50	28 ¹⁾ /50	28 ¹⁾ /50
Impulswithstand voltage	kV 9	5/125	95/125	95/125	95/125	95/125	95/125
Rated current	A	630/630		see ²⁾			200/200
Breaking capacities							
close loop	A	630/630					
off load cable charging	A	135/135					
off load transformer	A	20/20					
earth fault	A	200/150					
earth fault cable charging	A	115/87					
short circuit breaking current	kV			see ³⁾		21/16	
Making capacity	kV	52,5/40	52,5/40	see ³⁾	12,5/12,5	52,5/40	52,5/40
Short time current 1 sec.		kV			5/5	21/16	
Short time current 2 sec.	kV	21/16	21/16				21/16

1) 38 kV on request 2) Depending on the current rating of the fuse 3) Limited by high voltage fuse links

Dimensional drawings



Available modules



- C - Cable Switch
- F - Switch fuse disconnecter
- V - Vacuum circuit breaker
- D - Direct cable connection with earthing

If other configurations are required, they can be obtained through SafePlus, which is ABB's modular compact switchgear with identical user interface.

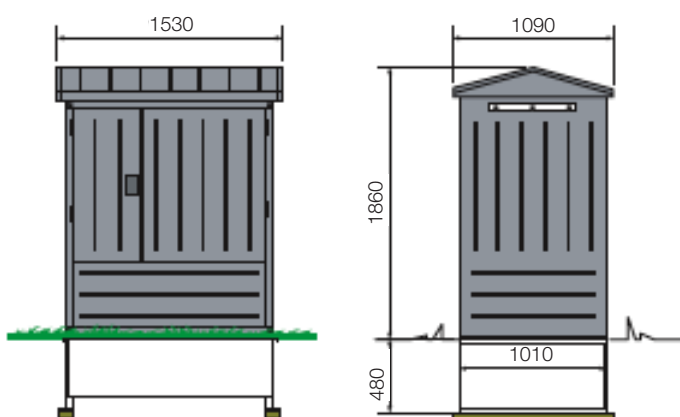
Junior 100 Outdoor Enclosure – Outdoor Enclosure for SafeRing and SafePlus

The outdoor enclosure is designed for SafeRing and SafePlus, up to 4-ways switchgear. The enclosure is designed to be mounted between two poles or on a standard aluminium foundation. The housing is assembled together from profiles. The profiles are joined together with one way non-corrosive screws which are not removable from outside. Both the enclosure and the roof is made of Aluzinc and painted with powder epoxy painting. The enclosure has two doors in the front allowing for easy operation. The doors are secured with two-point closing device with flush-mounted handle for padlock and vandal proof cover. The cover beneath the doors can be dismantled to give free access for cables. The cover on the backside can easily be dismantled too.

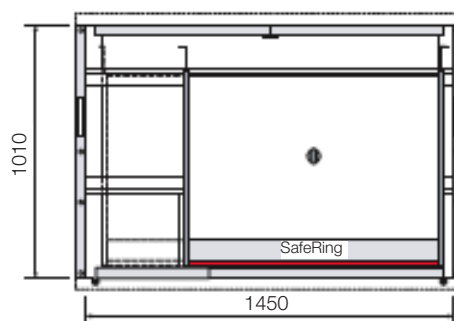


Dimensions

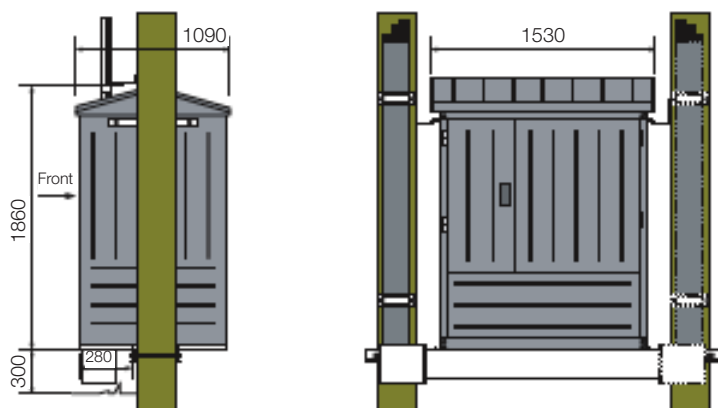
Outdoor enclosure on ground



Foundation on the ground



Outdoor enclosure - mounted between two poles



Dry Type Transformers

Dry type transformers are not flammable, they are self-extinguishing and in the event of a breakdown there is no risk of leakage of flammable or contaminating substances.

Construction features

ABB vacuum cast coil transformers range from 50 kVA up to 30 MVA with primary operating voltages up to 36 kV and secondary operating voltage up to 6 kV.

Customers demand dry type transformers more frequently in order to minimise environmental contamination and fire hazard. The emission of toxic substances and fumes is minimised. The use of cast resin, combined with our latest manufacturing techniques allows us to build stronger compact transformers capable of withstanding severe rolling and vibration.

Vacuum cast coil transformers are virtually maintenance free. They do not require any special civil works prior to installation and due to the particular design they can be repaired on site. ABB vacuum cast coil transformers are manufactured in accordance with the international quality standard ISO 9001.

Vacuum cast coil transformers are moisture-proof, suitable for operation in humid or heavily polluted environments. They are the ideal transformers for operation in environments with a humidity higher than 75% as well as at temperatures lower than 25°C.

Standard features

- HV coils vacuum cast in epoxy resin. LV windings pre-impregnated
- Casting process utilises high performance filled epoxy
- Aluminium windings, copper optional
- Step-lap mitered core
- 155°C insulation system and 100°C average temperature rise
- Four full capacity taps on HV winding rated $\pm 2 \times 2.5\%$



- Provisions for lifting core and coil assembly
- Rating plate
- Temperature control device
- Earthing terminals
- Base equipped with bi-directional rollers or designed for skidding

Core

ABB's dry type transformers utilise a step-lap mitered core construction to ensure optimum performance and minimum sound levels. The mitered core joint allows efficient flux transfer along natural grain lines between the core legs and yoke. The step-lap construction further enhances the efficiency of the joint by reducing joint fringing which reduces core losses and exciting currents.

The core is designed and built to provide the lowest possible losses from the effects of magnetic hysteresis and eddy currents. All possible steps are taken to prevent local circulating currents and to avoid built-in bending stresses.

As part of the quality process, ABB uses non-aging high permeability cold-rolled, grain-orientated silicon steel and constructs the core with step-lap mitered joints. Magnetic flux densities are kept well below the saturation point. The steel is precision cut to ensure that it will be smooth and burr-free. For rigidity and support, the upper and lower yokes are solidly clamped to a sturdy metal frame. The finished core is coated with a corrosion resistant sealant which provides lamination cohesion and environmental protection.

Windings

ABB's winding design depends on operating voltage, basic impulse level and the current capacity of the individual winding. ABB's Low-Voltage windings, insulation class 1.1 kV are usually wound with sheet conductors.

This construction allows free current distribution within the axial width of the coil which eliminates the axial forces developed in other types of windings under short-circuit conditions.

During the assembly process, each Low-Voltage winding is blocked radially and axially against the core using a combination of solid and resilient mounts for sound suppression and thermal expansion compensation.

The ABB winding construction is either round or oval up to 2500 kVA. Windings on transformers with ratings greater than 2500 kVA are generally round.

An experienced and dedicated work force ensures the quality of its work and the customer's satisfaction with the product.

Options and accessories

Design options

- 80°C average temperature rise (or other according to requirements)
- Copper windings
- Cast coil LV windings
- Increased basic impulse levels
- Dual primary-secondary voltage
- Loss optimised designs
- Retrofit designs
- Other designs available on request

Accessories

- Three-phase electronic temperature monitor
- Anti vibration pads
- Optional ventilated enclosure with removable front and rear panels (IP20 to IP65)
- Electronic screen
- Forced cooling package with three-phase electronic temperature monitor
- Air-filled terminal chambers
- Special paint colours
- Plug-in terminals (quick connectors)

Standard tests

- Transformation ratio at all taps and polarity
- Applied voltage
- Induced voltage
- Partial discharge test
- Resistance of all windings
- Vector group
- No-load loss and no-load current
- Load losses and impedance voltage test

Type tests

- Temperature rise test
- Lightning impulse test
- Measurement of noise level
- Insulation resistance

Humid or heavily polluted environments

- Use of epoxy resins – not hygroscopic
- Conductor protected from corrosion
- E2 class certified (tested for ambient 90% humidity and 50°C)
- C2 class certified (operation down to -25°C)
- Minimum dust accumulation

Partial discharge tests

- Routine test for partial discharge
- Below 5 pC

Fire hazards

- Neither dioxins nor hydrohalogen compounds
- Non toxic materials used
- F1 class certified
- Self-extinguishing
- Light transmission factor of fumes > 60%

Electrical and mechanical design

- Impulse test withstands voltage up to 200 kV
- Mechanically stronger, safe against vibrations and earthquakes
- Withstands thermal and dynamic short circuit effects

Specifications

- Self-Cooled Power Rating: 50-25.000 kVA
- Primary Voltage: withstands up to 36 kV
- Primary Lightning impulse voltage: withstands up to 170 kV
- Secondary Voltage: withstands up to 6 kV
- Secondary Lightning impulse voltage: withstands up to 60 kV
- Temperature Rise: 100/100 C

Oil Filled Transformers

MDT transformers are used to step down three-phase high voltage to low voltage for power distribution, mainly in metropolitan areas and for industrial applications.



Construction features

The transformers in standard versions are designed for use in moderate climates and can be installed both outdoors and indoors. The loading is in accordance with IEC 354. MDT transformers are hermetically sealed (the tank is completely filled with oil) or equipped with oil conservator. Both types are equipped with flexible corrugated tank walls enabling sufficient cooling of the transformer. They also compensate for the changes in the oil volume during operation. An advantage of the hermetically sealed transformers is that the oil is never in contact with the atmosphere thus avoiding periodic oil analysis.

Standard features

Hermetically sealed. (Rated power < 100 kVA)

- Oil filling plug on the cover
- Oil-level indicator
- The two lifting lugs on the cover are made for lifting the transformer or its removable part
- Corrugated tank

- Undercarriage with bi-directional rollers
- Oil drain valve
- Off-circuit tap changer handle
- Earthing terminals
- Sparking gaps for voltages 15 kV and above
- Rating plate

Additionally, for transformers with conservator (Rated Power ? 1000 kVA)

- Max thermometer
- Magnetic oil-level indicator
- Oil filling plug on the conservator
- Buchholz relay
- Dehydrating breather
- Conservator

Core

The cores of the transformers are made of grain oriented magnetic, cold-rolled silicon steel laminations with low losses.

Windings

The windings of the transformers are made of high grade electrolytic copper or aluminium. The High Voltage windings are wound either with round, enamel insulated, or shaped, paper insulated wire. The Low Voltage windings are wound with shaped, paper insulated wire or foil. The winding construction is characterised by high dielectric strength and high resistance to atmospheric surges and to the effects of short-circuits. Neutral points of the Low Voltage windings are brought to the tank cover.

Off-circuit tap changer

The off-circuit tap changer is of a 5-position type connected on the High Voltage side with a handle located on the cover. The tap changer should be operated only when the transformer is deactivated.

Insulating oil

The mineral oil with its electrical and chemical characteristics is in compliance with the IEC Standards and is P.C.B. and P.C.T. free.

Tank and cover

The cover is bolted to the tank frame. The transformer undercarriage is provided with bi-directional rollers turnable by $/2$ rad (90°) to allow longitudinal and transverse movement on flat surfaces.

Painting and surface treatment

All metal parts are carefully sandblasted. The painting is made with a single coat of one-pack epoxy paint. The finishing paint is made with two or three coats. If requested a hot-dip galvanised corrugated steel tank can be provided.

Options and accessories

- Plug-in bushings
- Dial type thermometer with two contacts
- DGPT2 control device
- Pressure relief valve with or without contacts
- Tap changer with more than five positions
- Cable boxes
- Spark gap meter
- Air insulated housings
- Galvanized tank
- Additional thermometer pocket
- Dual voltage transformer

Specifications

- Standards: IEC, DIN, BS, UNE, PN etc.
- 301-2000 kVA, three-phase, 65°C maximum windings temperature rise
- 50 Hz standard, 60 Hz optional
- High voltages 3000 – 35000 V
- Low Voltages 100 – 15750 V
- Vector group: Dy, Yz, Yy, Dd, Yd
- Impedance voltage: 4-7%
- Voltage regulation: $\pm 2 \times 2.5\%$; $\pm 2 \times 5\%$; $+2.5\%$, $-3 \times 2.5\%$

Resin-encapsulated Transformers

RESIBLOC® transformers with encapsulated windings provide the ultimate mechanical strength to withstand thermal and mechanical stresses from severe climates, cycling loads, and short circuit forces.



Construction features

The ABB resin-encapsulated dry-type transformer, RESIBLOC®, offers specific advantages. For more than a quarter of a century we have been using only epoxy resin and fibre-glass to encapsulate the wire layers. Epoxy resin moulding reinforced with fibre-glass rovings is a material of outstanding strength. Furthermore, we manufacture RESIBLOC® transformers without the addition of extenders or plasticisers. Electronically controlled winding processes ensure uniform distribution of the glass rovings and precise tracking.

The Low Voltage and High Voltage windings are joined adhesively by way of bars to form a compact block winding. The favourable impulse voltage distribution – resulting from the multilayering of the High Voltage winding – in conjunction with the outstanding strength of the coil makes RESIBLOC® resin-encapsulated transformers short-circuit proof.

The fibre-glass reinforcement of the resin-encapsulated RESIBLOC® windings is so robust that we have no hesitation in guaranteeing the crack resistance of the High Voltage coil for the entire life of the transformer.

We also guarantee that no silicone is used at any time in RESIBLOC® coil manufacture. This is a further key point for those operators who demand absolutely silicone free manufacture from their transformer suppliers.

Standard features

- Ratings: from 30 kVA to 30 MVA
- Primary Voltages: up to 41.5 kV
- Secondary Voltages: up to 36 kV

- BIL: According to standards
- HV Winding: Copper
- LV Winding: Aluminium
- Step-lap mitred core
- Tapping 2 x 2.5%
- Temperature device
- Fire class F1
- Environmental class E2
- Climatic class C2
- Built-in cooling channels to dissipate heat
- Environmentally friendly
- Linear distribution of lightning impulse voltage
- Base equipped with bi-directional rollers or designed for skidding arrangement

Options and accessories

- Dimensions adaptable to specific requirements
- Loss optimized design
- Special designs as traction, rectifier and converter transformer, multiwinding transformers
- Enclosure IP20 to IP65, indoor and outdoor, galvanised without painting
- Fans for forced cooling (up to 140% of AN rating), including control
- Anti-vibration pads, (1 set = 4 pieces)
- Earthing bolts (1 set = 3 pieces)
- PTC sensors, with relay
- Dial type thermometer (with capillary tube 2m)
- Thermo-resistor PT100
- Copper for LV windings
- Reduced temperature rise on request

Certified test results

- Safe to store and transport at -60°C (standard test requirement only -25°C)
- Tested with twice rated current at -40°C (standard test requirement only -25°C)
- Vibration tested for installation in seismic areas. Acceleration tested to 12.5g
- All components tested for non-toxicity
- Repeated thermal shock with hot air 120°C and cold air -10°C (over 10 times)

Fire proof

- Approx. 80% fibreglass in winding insulation
- Only non-toxic materials
- Max 5% calorific energy of comparable oil type unit
- No halogens, nor sulphur (fluorine/chlorine/bromine)
- Every unit guaranteed to be self-extinguishing. Fire Class 1 certified

Short circuit proof

- High mechanical stability of coil structure
- Diagonally and radially fibreglass braced (HV-winding)
- Turns glued to each other with prepreg (LV winding)
- HV and LV windings form a singular coil
- Coil structure will withstand radial forces in short circuit conditions

Moisture and pollution proof

- 100% humidity and condensation proof
- Strong presence in off-shore applications
- High resistance to chemical pollution
- Long-term molecular stability due to absence of flexibilisers

Crack proof

- Severe thermo-shock tested
- Severe hot/cold dip tests
- Physical and mechanical properties of coil components optimised
- High resistance to extremely low ambient temperatures
- Performance stability under extreme load conditions
- Not a single crack registered to date

Minimal dust accumulation

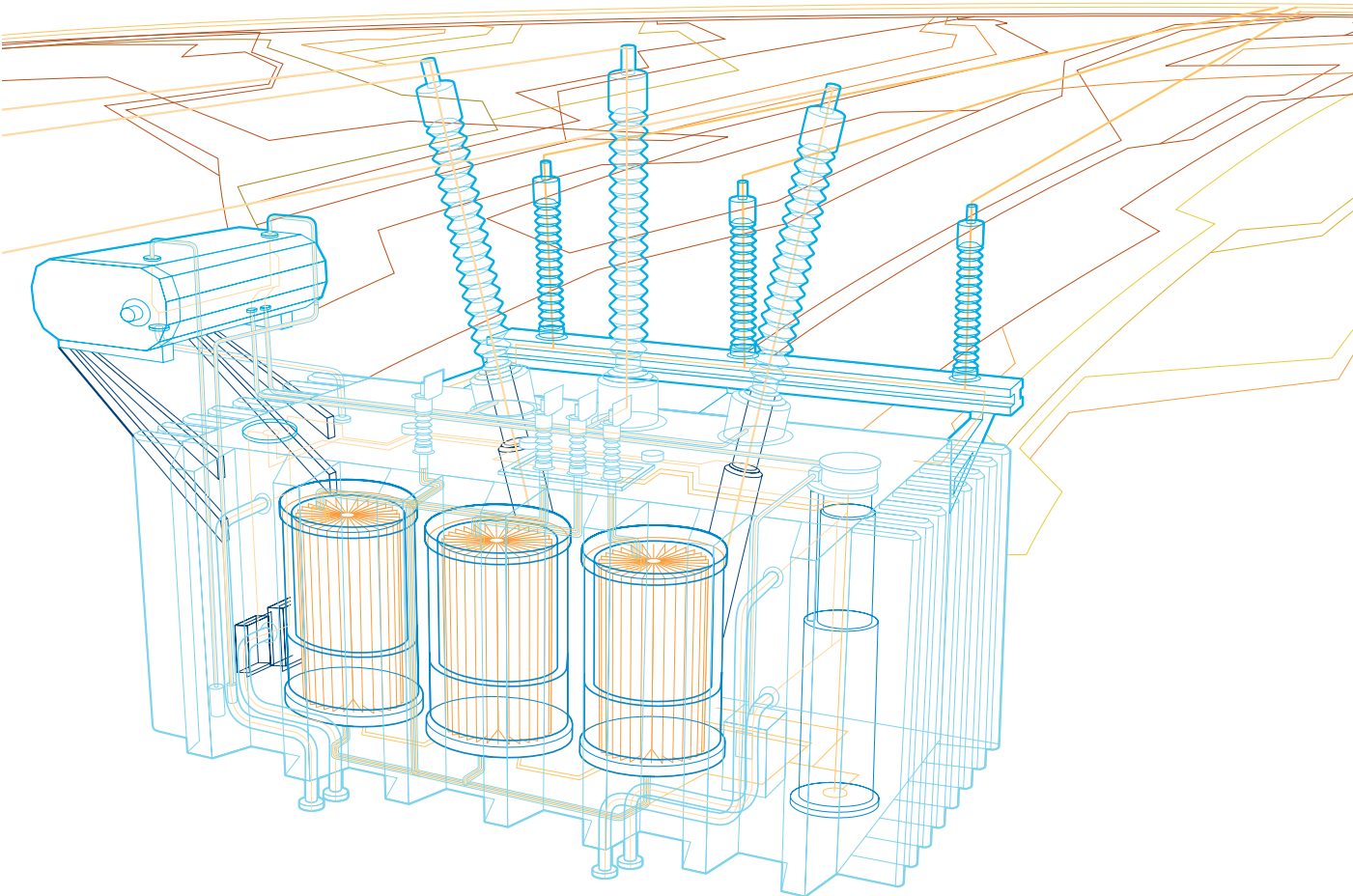
- Vertical cooling channels with chimney effect
- Minimum dust settles
- No horizontal ducts
- Small upper coil surface
- Surface structure non-adhesive to dust

Transformer Ratings

Rated Currents and Short-Circuit Currents of 3 Phase 400v Transformer

No of transformers and rated output	Current rating of transformer	Total available current	Maximum prospective short circuit current
KVA	A	A	KA
1 x 500	722	722	18.0
2 x 500	722	1444	36.0
1 x 630	910	910	22.7
2 x 630	910	1820	45.4
3 x 630	910	2730	68.1
1 x 800	1156	1156	23.1
2 x 800	1156	2312	46.2
3 x 800	1156	3468	69.3
1 x 1000	1444	1444	28.9
2 x 1000	1444	2888	57.8
3 x 1000	1444	4332	86.7
1 x 1250	1805	1805	36.1
2 x 1250	1805	3610	72.2
3 x 1250	1805	5412	108.3
1 x 1600	2312	2312	37.0
2 x 1600	2312	4624	74.0
3 x 1600	2312	6936	111.0
1 x 2000	2890	2890	46.2
2 x 2000	2890	5780	92.4
1 x 2500	3610	3610	57.7

NOTE: The above ratings do not take into account impedance of busbars, connections to circuitbreakers or cables



Air Circuit Breakers

Air circuit breakers can be used both as circuit-breakers for general protection (of plants and electric lines) and as protection circuit breakers of electrical machines (generators, motors, transformers, capacitors).

They are used in all types of plants (civil, industrial, and in the service sector) as well as in the equipment on-board ships, in mines, in prefabricated substations, and for primary and secondary distribution in general.

Specific characteristics

All the SACE Emax circuit-breakers have the same height and depth both in the fixed and withdrawable version and allow construction of compact switchgear.

They are fitted with many features which mean that personnel can always work under conditions of maximum safety, such as racking-out with the door closed, degree of protection towards the outside up to IP54, an articulated series of safety locks and double insulation.

The innovative structure of the pole guarantees complete insulation between phases and between phase and neutral and allows for inspection of the arcing chamber and the main contacts.

SD Pocket is an innovative function which means a PC, even a hand-held one, can dialogue with Emax by means of the Bluetooth protocol. By means of the PC, and without any cables, the following is now possible, for example: the setting of the various protections, display of the measurements including those stored in the Data Logger, verification of the state of the circuit-breaker, number of operations carried out, etc..

Conformity with Standards

The SACE Emax circuit-breakers and their accessories comply with the international IEC 947, EN 60947 (harmonised in 28 countries of the CENELEC), CEI EN 60947 and IEC 1000 Standards and conform to the EC Directive:

- "Low Voltage Directives" (LVD) no. 73/23 EEC
- "Electromagnetic Compatibility Directive" (EMC) no. 89/336 EEC

Furthermore, a series of SACE Emax circuitbreakers conforming to the UL 1066 Standards are available.

Range of apparatus

Air circuit breakers are available for a large number of applications. The new series of air circuit-breakers consists of five sizes (E1, E2, E3, E4 and E6) in the fixed and withdrawable versions, with rated uninterrupted currents from 800 to 6300 A and breaking capacities up to 150 kA at 415 V. Different models of circuitbreakers for each size are available, all with the same

dimensions, but with various rated currents and with different breaking capacities, identified by letters.

The series is completed by a range of currentlimiting circuit-breakers, of different construction concept, particularly recommended in plants characterised by high short-circuit currents.

Customisation of the circuit-breaker is carried out by means of a complete range of accessories - common over the whole range, which can be installed from the front of the circuit-breaker without the need for any internal cabling.

For protection in alternating current, the circuitbreakers are fitted with the new series of electronic releases which offer the following main characteristics:

- SACE PR121/P, the basic release with the following protection functions: overload(L), selective short-circuit(S), adjustable instantaneous short-circuit(I) and Earth fault(G)
- SACE PR122/P, the intermediate release. It offers, further to protection (L, S, I, G), measuring and communication functions
- SACE PR123/P, the advanced release. In addition to the above units, it offers more communication and measuring capabilities and other functions like, for example: harmonic analyses, directional protection and phase rotation



ACB sizes & ratings						
		E1	E2	E3	E4	E6
Rated current I _u	[A]	800-1600	800-2000	800-3200	3200-4000	3200-6300
I _u N (4 poles CB)	[%I _u]	100	100	100	50	50
U _e AC (50-60 Hz)	[V]	690	690	690	690	690
U _i	[V]	1000	1000	1000	1000	1000
U _{imp}	[kV]	12	12	12	12	12
Test voltage (50 Hz, 1 min)	[V]	3500	3500	3500	3500	3500
N° of poles	[No.]	3-4	3-4	3-4	3-4	3-4
Breaking capacities						
I _{cu} AC 50-60 Hz 220-415 V	[kA]	42-50	42-130	65-130	75-150	100-150
I _{cu} AC 50-60 Hz 440 V	[kA]	42-50	42-110	65-130	75-150	100-150
I _{cu} AC 50-60 Hz 500-690 V	[kA]	42-50	42-85	65-100	75-100	100
I _{cs} AC 50-60 Hz 220-415 V	[kA]	42-50	42-130	65-130	75-150	100-125
I _{cs} AC 50-60 Hz 440 V	[kA]	42-50	42-110	65-110	75-150	100-125
I _{cs} AC 50-60 Hz 500-690 V	[kA]	36	42-65	6-85	75-100	100
I _{cw} (1s)	[kA]	42-50	10-65	15-85	75-100	100
I _{cw} (3s)	[kA]	36	42	65	75	75-85
I _{cm} (peak value)						
I _{cm} AC 50-60 Hz 220-415 V	[kA]	88.2-105	88.2-286	143-286	165-330	220-330
I _{cm} AC 50-60 Hz 440 V	[kA]	88.2-105	88.2-242	143-242	165-330	220-330
I _{cm} AC 50-60 Hz 500-690 V	[kA]	75.6	84-187	143-187	165-220	220
Category of use (IEC 60947-2)		B	A-B	A-B	B	B
Isolation behaviour (IEC 60947-2)		X	X	X	X	X
Overcurrent protection						
Electronic releases for AC applications		X	X	X	X	X
Operating times						
Closing time (max)	[ms]	80	80	80	80	80
Trip time for I<I _{cw} (max) (1)	[ms]	70	70	70	70	70
Trip time for I<I _{cw} (max)	[ms]	30	12-30	12-30	30	30
Overall dimensions						
F.: H= 418mm - D= 302mm - L (3/4 p.)	[mm]	296-386	296-386	404-530	566-656	782-908
W.: H= 461mm - D= 396.5 mm - L (3/4 p.)	[mm]	324-414	324-414	432-558	594-684	810-936
Weights						
Fixed 3/4 poles	[kg]	45-54	50-63	66-83	97-117	140-160
W 3/4 poles (including fixed part)	[kg]	70-82	78-95	104-127	147-190	210-260
Version		F-W	F-W	F-W	F-W	F-W

(1) without intentional delays

Versions caption:

F fixed

W withdrawable

NOTE: For more information please refer to Emax Technical catalogue

Moulded Case Circuit Breakers

The moulded-case circuit-breakers, proposed by ABB SACE, derive from the T-Max family series (Top selection at Intel Design 2003 for their technological content and respect of the environment).

In particular, Tmax are characterised by an extremely high level of performances with limited overall dimensions, installation simplicity and an increasingly greater guarantee of safety for the operator thanks to their reinforced insulation. Tmax circuit-breakers can be used for all distribution and sub-distribution application for both AC and DC electrical plants.

Specific characteristics of Tmax

The Tmax series is characterised by being a product with a high technological content - the fruit of the most advanced design and simulation tools with excellent performances in minimum overall dimensions.

Thanks to the new technology used for the arcing chambers and the speed of contact opening, the circuit-breakers of the Tmax series guarantee strong limitation of the specific let-through energy and reduction in the peak currents, therefore limiting overheating of the devices and electro-dynamic stresses. Furthermore, the new Tmax circuit-breakers use a completely common and standardised range of accessories with considerable advantages in terms of reduced stocks as well as flexibility and ease of use. Then within this range there are also the new residual current releases up to 500 A.

Field of application

The moulded-case circuit-breakers are used in industrial and civil low voltage plants with service currents from 1 to 3200 A. They are used in direct and alternating current distribution switchgear, for motor protection (Motor Control Center), generators, capacitors and for end users.

The ranges

The ABB moulded case circuit-breakers are proposed into eight sizes: T1, T2, T3, T4, T5, T6, T7 and T8. The rated ultimate breaking capacity under short-circuit, I_{cu} , at 380/415V AC is available starting from 16kA up to 200kA. To fulfil the various application requirements, they are available in the following ranges:

- Circuit-breakers for AC and DC power distribution
- Circuit-breakers for motor protection
- Circuit-breakers for applications up to 1000 V AC and DC
- Switch-disconnectors

For each size, circuit-breakers are available in the three and four-pole versions. They are also equipped with a complete range of protection releases: thermomagnetic, magnetic only adjustable and electronic releases of the latest generation. T1, T2, T3, T4, T5 and T6 circuit-breakers fitted with TMD and TMA thermomagnetic releases can also be used in direct current plants, with a field of application from 1A to 800 A and a minimum operating voltage of 24V DC.



Power distribution circuit-breakers

The ABB SACE family of moulded case circuit breakers are divided into different, perfectly integrated, ranges (Tmax T1B 1p, T1, T2, T3, T4, T5, T6 T7 and T8), able to cover a range of service currents from 1 to 3200 A. The power distribution circuit breakers are available in the fixed, plug-in or withdrawable, three-pole and four-pole versions. The Tmax T1 circuit breaker is also available in the single pole Tmax T1B 1p version, with breaking capacities of 25 kA at 220/230 V AC.

Interchangeability of the releases

The Tmax circuit-breakers can be fitted either with thermomagnetic, magnetic only or electronic releases, which are all interchangeable with each other. In fact, thanks to the simplicity of their installation, the type of release can be replaced rapidly even by the end user, according to their requirements and needs: in this case, correct assembly remains the responsibility of the user himself. All this means increasing the flexibility of use of the circuit-breakers, with considerable savings thanks to the better rationalisation of stock management.

Conformity with Standards

The moulded-case circuit-breakers and their accessories conform to the IEC 60947-2 international Standards and comply with the EC "Low Voltage Directives (LVD) no. 73/ 23 EEC" and "Electromagnetic compatibility Directives (EMC) no. 89/336 EEC". ABB SACE's Quality System conforms to the ISO 9001 International Standard and to the equivalent European EN ISO 9001 and Italian UNI EN ISO 9001 Standards. The certifying Body is the Italian Shipping Register (RINA - QUACER): ABB SACE has reached its third qualification confirmation. The ABB SACE Test Room is accredited by SINAL. The apparatus conforms to the prescriptions of the on-board installations and approvals by the major Shipping Registers are in progress.

MCCB size & rating										
		T1 1p	T1	T2	T3	T4	T5	T6	T7	T8
Iu	[A]	160	160	160	250	250	400	630	800	2000
						320	630	800	1000	2500
								1000	1250	3200
									1600	
N° of poles	No.	1	3-4	3-4	3-4	3-4	3-4	3-4	3-4	3-4
Ue AC 50-60Hz	[V]	240	690	690	690	690	690	690	690	690
UeDC	[V]	125	500	500	500	750	750	750	-	-
Uimp	[kV]	8	8	8	8	8	8	8	8	12
Ui	[V]	500	800	800	800	1000	1000	1000	1000	1000
Testvoltage										
(50 Hz, 1 min.)	[kV]	3	3	3	3	3.5	3.5	3.5	3.5	3.5
Breaking capacities										
Icu AC 50-60 Hz 380/415 V	[kA]	25	16	36	36	36	36	36	50	85
		(1)(2)	36	85	50	200	200	100	150	130
Icu AC 50-60 Hz 690 V	[kA]		3	6	5	20	20	20	30	50
			6	10	8	80	80	150	60	80
Icu DC 500 V - 3 p in series	[kA]	25	16	36	36	16	16	20	-	-
		(3)	36	85	50	70	70	65		
Ics AC 50-60 Hz 380/415 V	[kA]	18	16	36	27	36	36	35	50	85/110.5
			25	70	200	200	150	60		
Category of use (IEC 60947-2)		A	A	A	A	A	B/A	B	B	B
Mechanical life										
N. op x [103]	No	25	25	25	25	20	20	20	10	10
Electrical life @ 415 V										
N. op x [103]	No	8	8	8	8	8	7	7	2	2.5
						6	5	5	3	1.5
Protection releases*										
TMF		X								
TMD			X	X		X				
TMA					X	X	X	X		
TMG					X		X			
ELT				X		X	X	X	X	X
Dimensions (fixed version)										
Width 1 pole	[mm]	25.4								
Width 3 poles	[mm]		76	90	105	105	140	210	210	427
Width 4 poles	[mm]		102	120	140	140	184	280	280	553
Depth	[mm]	70	70	70	70	103.5	103.5	103.5	154man/178mot	282
Height	[mm]	130	130	130	150	205	205	268	268	382
								406		
Versions										
Fixed		F	F	F	F	F	F	F	F	F
Plug-in				P	P	P	P			
Withdrawable						W	W	W	W	

NOTE: For more info please refer to Tmax technical catalogue

(1) for In=16 A and In = 20 A Icu = 16 k A

(2) Icu @ 230 V AC

(3) Icu @ 125 V DC

*Caption:

TMF = themomagnetic fixed release

TMD = thermomagnetic with adjustable thermal release

TMA = thermomagnetic with adjustable thermal and magnetic release

TMG = release for generator protection

ELT = electronic release

Circuit-breakers for motor protection

Starting, switching and protection of three-phase asynchronous motors are fundamental operations for their correct use. ABB SACE proposes two different solutions for this type of application

in the series of moulded-case circuit-breakers:

- a traditional system which has a circuit-breaker for protection against the short-circuit, a thermal relay for protection against overload and missing or unbalanced phase and a contactor for motor switching
- a system of integrated protection, thanks to the PR222MP release, which ensures the following protections: against short-circuit, overload, against missing or unbalanced phase, and against rotor locking

Field of application

Available in six sizes (T2, T3, T4, T5, T6 and T7), they can be used in a vast range of start-ups, from 0.37 kW upto 355 kW at 400 V AC.

System pro M Compact – Miniature Circuit Breakers, Residual Current Devices & Modular Din Rail Components

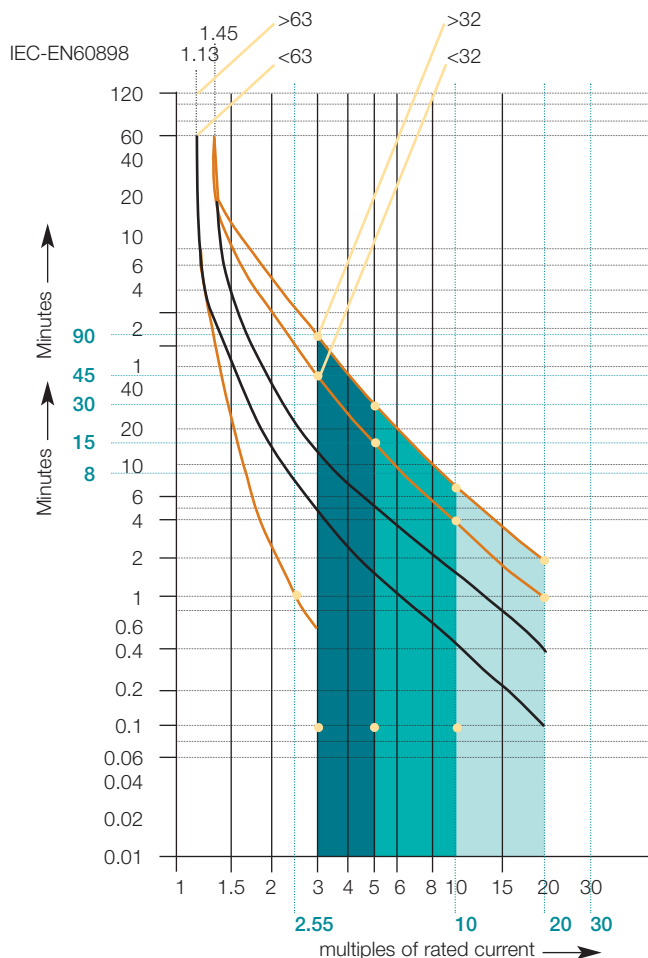


Miniature Circuit Breakers

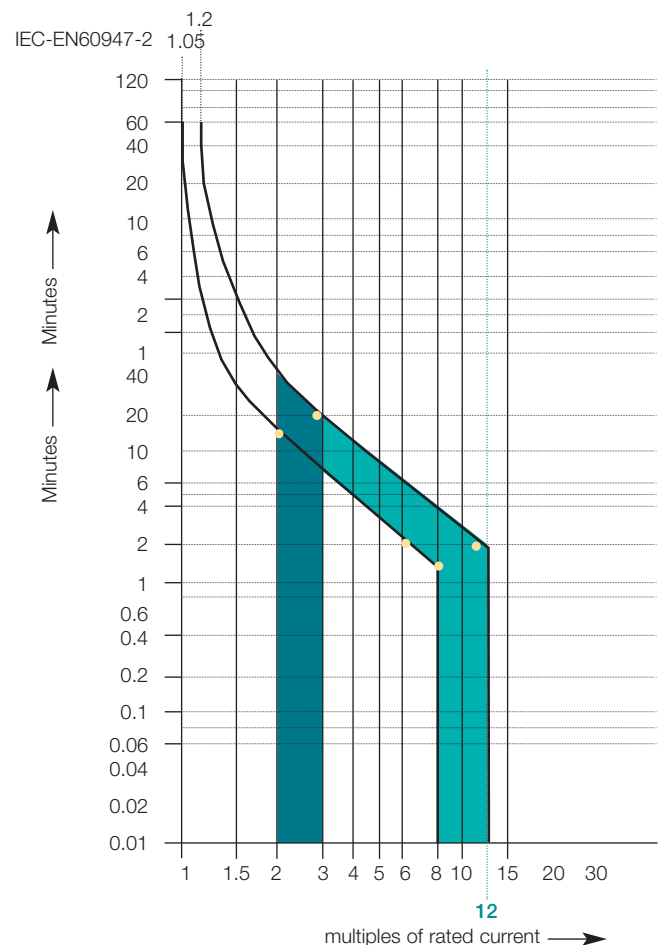
MCBs protect installations against overload and shortcircuit, warranting reliability and safety for operations. New System pro M compact S 200 series satisfies most common requirements in terms of MCBs, allowing the usage of them for domestic, industrial and commercial applications. Three series – S 200, S

200 M and S 200 P – with three different breaking capacities up to 25 kA are available, in all characteristics (B, C, D, K and Z) and configurations (1P, 1P+N, 2P, 3P, 3P+N and 4P), in all the sizes up to 63 A. A space saving version with an integrated auxiliary contact is also available. All these MCBs comply to IEC/EN 60898 and IEC/EN 60947-2 Standards.

Characteristics B, C, D



Characteristics K, Z



RCDs assure a protection to people and installations against fault current to earth. They are divided into three families:

- **RCCBs**, which are sensitive only to earth fault current (therefore they have to be connected in series with a MCB or a fuse to protect them against overcurrents and short circuits)
- **RCD-blocks**, which are devices to be assembled on an MCB with lower or equal rated current to provide protection against both earth-fault currents and overload or short-circuits
- **RCBOs**, which combines, in a single device, protection against both earth-fault currents and overloads or short-circuits

New RCDs System pro M compact range presents a wide offer for all the three families, respectively **F 200**, **DDA 200** and **DS 200** series.

A large offer for standard instantaneous and selective AC and A types is completed with some configurations for special applications, like AP-R type against perturbations or AE type for emergency stop.

Sizes up to 63A with sensitivity thresholds up to 1A are available.

Functions and classification criteria for RCDs

A residual current operated circuit-breaker is an amperometric protection device which is tripped when the system leaks a significant current to earth.

This device continuously calculates the vector sum of the single-phase or three-phase system line currents and while the sum is equal to zero allows electricity to be supplied. This supply is rapidly interrupted if the sum exceeds a value preset according to the sensitivity of the device.

Residual current operated circuit-breakers can be classed according to four parameters:

- type of construction
- detectable wave form
- tripping sensitivity
- tripping time

Depending on the type of construction, RCDs may be classed as:

- RCBOs (magnetothermal with overcurrent protection)
- RCCBs (without overcurrent protection releaser incorporated)
- RCD blocks

RCBOs combine, in a single device, the residual current function and the overcurrent protection function typical of MCBs. RCBOs are tripped by both current leakage to earth and overloads and short-circuits and they are self-protecting up to a maximum short-circuit current value indicated on the label.

RCCBs are only sensitive to current leakage to earth. They must be used in series with an MCB or fuse which protects them from the potentially damaging thermal and dynamic stresses of any overcurrents.

These devices are used in systems already equipped with MCBs which preferably limit the specific energy passing through, also acting as the main disconnecting switches upstream of any derived MCBs (e.g.: domestic consumer unit).

RCD blocks are residual current devices suitable for assembly with a standard MCB. IEC/EN 61009 app. G only allows assembly of RCBOs once on site, that is to say outside the factory, using adaptable RCD blocks and the appropriate MCBs. Any subsequent attempts to separate them must leave permanent visible damage. The residual current operated circuit-breaker obtained in this way maintains both the electrical characteristics of the MCB and those of the RCD block.

According to the wave form of the earth leakage currents they are sensitive to, the RCDs may be classed as:

- AC type (for alternating current only)
- A type (for alternating and/or pulsating current with DC components)
- B type (for alternating and/or pulsating current with DC components and continuous fault current)

AC type RCDs are suitable for all systems where users have sinusoidal earth current.

They are not sensitive to impulsive leakage currents up to a peak of 250 A (8/20 wave form) such as those which may occur due to overlapping voltage impulses on the mains (e.g.: insertion of fluorescent bulbs, X-ray equipment, data processing systems and SCR controls).

A type RCDs are not sensitive to impulsive currents up to a peak of 250 A (8/20 wave form).

They are particularly suitable for protecting systems in which the user equipment has electronic devices for rectifying the current or phase cutting adjustment of a physical quantity (speed temperature, light intensity, etc.) supplied directly by the mains without the insertion of transformers and insulated in class I (class II is, by definition, free of faults to earth). These devices may generate a pulsating fault current with DC components which the A type RCD can recognise.

Other modular functions

Protective devices

Residual current monitors, toroidal transformers, fuseholders, surge protection.

Command devices

Installation relays, switches, latching relays, push button and indicator lamps, dimmers, time delay and digital timeswitches.

Load management devices

Light level switches, overload alarms, current/voltage, under voltage relays and mains disconnecting relays.

Other modular functions

Bell transformers, bells, buzzers, pushbuttons and power supply units.

Motor Control Gear



ABB offer the most comprehensive range of motor control devices and accessories found on the market today. With acquired years of experience with respect to problems of co-ordination ABB is able to make a complete offer based on tests performed in qualified laboratories. This offer includes 400V, 500V and 690V networks. A complete database of co-ordination tables, according to IEC 60947-4-1 (EN 60947-4-1) is available on the ABB website (www.abb.com).

ABB Motor Control Gear

Contactors:	Mini and block contactors. 3 + 4 pole 9-1600A AC+DC operated Specific applications – DC circuit switching, capacitor switching, lighting circuit switching.	Relays:	supplies, solid state relays, signal converters, logic modules.
Manual Motor Starters:	Thermal + electromagnetic protection 0.16 – 100A up to 100kA.	Sensors:	Inductive and capacitive, proximity, photoelectric and ultrasonic wireless sensors.
Overload Relays:	Thermal + Electronic 0.1 – 1250A Heavy duty and ATEX applications.	Limit Switches:	30, 40 + 60 in metal and plastic double insulated housings, safety limit switches and latches.
Pilot Devices:	Push buttons, pilot lights, selector switches, key operated switches, potentiometers and buzzers.	Terminals:	Screw clamp, spring clamp, insulation displacement, power terminals, quick connect terminals, pluggable terminals.
Soft Starters:	3-1810 A, Integrated by-pass contactors, LCD display, flexible BWS communications.	Motors:	Full, comprehensive range for power generation, transmission, industrial and rail transportation and distribution.
Field Bus Plug:	Universal bus communication device for all common BWS applications.	Why not visit our website for the most comprehensive selection of tools available – www.abb.com/lowvoltage	
Electronic Protection	Electronic timers, measuring and monitoring relays, interface relays, safety relays, switching power		

Motive Power KW Rating

The currents given below concern standard three-phase four-pole cage motors (1500 r.p.m. at 50 Hz. 1800 r.p.m. at 60 Hz). These values are given for guidance and may vary according to the motor manufacturer and depending on the number of poles.

IEC Motor nominal current: standardised values in blue colour (according to IEC 60947-4-1 Annex G)										
Motor Power kW	220 V	230 V	240 V	380 V	400 V	415 V	440 V	500 V	660 V	690 V
	A	A	A	A	A	A	A	A	A	A
0.06	0.37	0.35	0.34	0.21	0.2	0.19	0.18	0.16	0.13	0.12
0.09	0.54	0.52	0.50	0.32	0.3	0.29	0.26	0.24	0.18	0.17
0.12	0.73	0.7	0.67	0.46	0.44	0.42	0.39	0.32	0.24	0.23
0.18	1	1	1	0.63	0.6	0.58	0.53	0.48	0.37	0.35
0.25	1.6	1.5	1.4	0.9	0.85	0.82	0.74	0.68	0.51	0.49
0.37	2.0	1.9	1.8	1.2	1.1	1.1	1.0	0.88	0.67	0.64
0.55	2.7	2.6	2.5	1.6	1.5	1.4	1.3	1.2	0.91	0.87
0.75	3.5	3.3	3.2	2.0	1.9	1.8	1.7	1.5	1.15	1.1
1.1	4.9	4.7	4.5	2.8	2.7	2.6	2.4	2.2	1.7	1.6
1.5	6.6	6.3	6.0	3.8	3.6	3.5	3.2	2.9	2.2	2.1
2.2	8.9	8.5	8.1	5.2	4.9	4.7	4.3	3.9	2.9	2.8
3	11.8	11.3	10.8	6.8	6.5	6.3	5.7	5.2	4.0	3.8
4	15.7	15	14.4	8.9	8.5	8.2	7.4	6.8	5.1	4.9
5.5	20.9	20	19.2	12.1	11.5	11.1	10.1	9.2	7.0	6.7
7.5	28.2	27	25.9	16.3	15.5	14.9	13.6	12.4	9.3	8.9
11	39.7	38	36.4	23.2	22	21.2	19.3	17.6	13.4	12.8
15	53.3	51	48.9	30.5	29	28.0	25.4	23	17.8	17
18.5	63.8	61	58.5	36.8	35	33.7	30.7	28	22.0	21
22	75.3	72	69	43.2	41	39.5	35.9	33	25.1	24
30	100	96	92	57.9	55	53	48.2	44	33.5	32
37	120	115	110	69	66	64	58	53	40.8	39
45	146	140	134	84	80	77	70	64	49.1	47
55	177	169	162	102	97	93	85	78	59.6	57
75	240	230	220	139	132	127	116	106	81	77
90	291	278	266	168	160	154	140	128	97	93
110	355	340	326	205	195	188	171	156	118	113
132	418	400	383	242	230	222	202	184	140	134
160	509	487	467	295	280	270	245	224	169	162
200	637	609	584	368	350	337	307	280	212	203
250	782	748	717	453	430	414	377	344	261	250
315	983	940	901	568	540	520	473	432	327	313
355	1109	1061	1017	642	610	588	535	488	370	354
400	1255	1200	1150	726	690	665	605	552	418	400
500	1545	1478	1416	895	850	819	745	680	515	493
560	1727	1652	1583	1000	950	916	832	760	576	551
630	1928	1844	1767	1116	1060	1022	929	848	643	615
710	2164	2070	1984	1253	1190	1147	1043	952	721	690
800	2446	2340	2243	1417	1346	1297	1179	1076	815	780
900	2760	2640	2530	1598	1518	1463	1330	1214	920	880
1000	3042	2910	2789	1761	1673	1613	1466	1339	1014	970

Utilisation Categories:

A contactor's duty is characterised by the utilization category together with the rated operational voltage and current indicated.

Utilization Categories for Contactors According to IEC 60947-4-1:

Alternating current

AC-1	Non-inductive or slightly inductive loads, resistance furnaces.
AC-2	Slip-ring motors: starting, switching off.
AC-3	Cage motors: starting, switching off running motors.
AC-4	Cage motors: starting, switching off running motors.
AC-5a	Discharge lamp switching.
AC-5b	Incandescent lamp switching.
AC-6a	Transformer switching.
AC-6b	Capacitor bank switching.
AC-8a	Hermetic refrigeration compressor motor control with manual resetting of overload releases.
AC-8b	Hermetic refrigeration compressor motor control with automatic resetting of overload releases.

Direct current:

DC-1	Non inductive or slightly inductive loads, resistance furnaces.
DC-3	Shunt motors: starting, plugging, inching, dynamic breaking of d.c. motors.
DC-5	Series motors: starting, plugging, inching, dynamic breaking of d.c. motors.
DC6	Incandescent lamp switching.

Types of Co-ordination

IEC 60947-4-1 (EN 60947-4-1) defines two types of co-ordination according to the expected level of service continuity. Acceptable extreme damage for the switchgear is divided into two types.

Type 1: In short-circuit conditions, the contactor or starter does not endanger persons or installations and will not be able to then operate without being repaired or having parts replaced.

Type 2: In short-circuit conditions, the contactor or starter does not endanger persons or installations and will be able to operate afterwards. The risk of contacts light welding is acceptable.

Low Voltage AC & DC Drives

ABB drives bring together a world leading and recognized brand which has carved a niche as global number one supplier for low voltage AC drives and DC drives.



The Range

- Machinery Drives
- Standard Drives
- Industrial Drives
- DC Drives

ABB AC drives

The ABB AC drives product range is the widest available from any manufacturer, from 0.18 to 5600 kW. ABB drives is a reference for drives users the world over that signifies reliability, simplicity, flexibility and ingenuity, throughout the lifecycle of an AC drive.

ABB machinery drives

ABB offers machinery builders AC drives from component drives up to high performance machinery drives. Global support and service guarantees lifelong satisfaction. ABB machinery drives provide speed control of diverse applications from spa

bathmotors to treadmill motors, as well as high precision applications such as positioning and synchronisation systems.

ABB machinery drives

ACS55

Power range 0.18 to 0.37 kW (1-phase, 100 to 120 V)

Power range 0.18 to 2.2 kW (1-phase, 200 to 240 V)

ACS150

Power range 0.37 to 2.2 kW (1-phase/3-phase, 200 to 240 V)

Power range 0.37 to 4 kW (3-phase, 380 to 480 V)

ACS350

Power range 0.37 to 2.2 kW (1-phase, 200 to 240 V)

Power range 0.37 to 11 kW (3-phase, 200 to 240 V)

Power range 0.37 to 22 kW (3-phase, 380 to 480 V)

ACSM1

Power range 0.75 to 160 kW (3-phase, 380 to 480 V)

ABB standard drives

ABB standard drives are simple to buy, install, configure and use, saving considerable time. They are widely available through ABB's distributors, hence the use of the term standard. The drives have common user and process interface with fieldbus, common software tools for sizing, commissioning, maintenance and common spare parts.

ABB industrial drives

ABB industrial drives are designed for applications such as those in process industries like pulp & paper, metals, mining, cement, power, chemical, oil & gas and food & beverage. ABB industrial drives are available as complete AC drives and as modules to meet the requirements of the users, OEMs and system integrators. These highly flexible AC drives can be tailored to meet the precise needs of industrial applications and as such specific configuration of the drive can be carried out during ordering. The complete drives and modules cover a wide range of powers and voltages up to 690 V. ABB industrial drives come with a broad selection of inbuilt options. These drives can be easily programmed which makes adaptation to different applications easy.

ABB DC drives

ABB DC drives offer the highest power to size ratio along with onboard field exciters and integrated PLC, making them the most suitable DC drive for all new and retrofit applications. The auto-tuning facility and the self-explanatory intelligent software minimises the start-up time, eases daily operation and increases your productivity and quality.

ABB DC drives can be used in most industries such as metals, cement, mining, pulp & paper, printing, food & beverages, wire drawing, test rigs, ski lifts and cranes. The drives are also suitable for non-motor uses like DC chargers and electromagnetic applications.

ABB offers three-phase DC drives ranging from 9 kW (12 hp) up to 18 MW (24000 hp).

ABB DC drives can be delivered as converter modules, complete cabinets and retrofit kits.

ABB standard drives

ACS310

Power range 0.37 to 11 kW (3-phase, 200 to 240 V)

Power range 0.37 to 22 kW (3-phase, 380 to 480 V)

ACS550-01

Power range 0.75 to 75 kW (3-phase, 200 to 240 V)

Power range 0.75 to 160 kW (3-phase, 380 to 480 V)

ACS550-02

Power range 200 to 355 kW (3-phase, 380 to 480 V)

ABB industrial drives

ACS800, drive modules

Power range 0.55 to 2000 kW (230 to 690 V)

ACS850, drives modules

Power range 1.1 to 500 kW (380 to 500 V)

ACQ810, drive modules

Power range 1.1 to 400 kW (380 to 480 V)

ACS800, single drives

Power range 0.55 to 5600 kW (230 to 690 V)

ACS800, multidrives

Power range 1.1 to 5600 kW (380 to 690 V)

ABB DC drives

Power range 9 to 18 MW
6 pulse or 12 pulse systems

DCS400 series

3-phase 230 to 500 V AC

20 to 1000 A DC

DCS800-S series

230 to 1000 V AC

20 to 5200 A

DCS800-A series

230 to 1200 V AC

20 to 20000 A

Power Factor Correction – Capacitor Units type CLMD

Modular Design

The CLMD capacitor is a unit that lends itself easily to modular systems.

Dry Type Design – Low Losses

The dielectric of the CLMD capacitor is made of dry type low loss polypropylene, a system that offers very low dielectric losses and does not give any risk of leakage. Typical losses less than 0.2 Watt/KVAR (excluding discharge resistors).

Long Life-Self Healing

The self-healing properties of the capacitor elements ensure the long life of the CLMD capacitor.

Protection and Safety

The CLMD capacitor incorporates the well known vermiculite filling of ABB's capacitors, an efficient means of obtaining a safe protection.

Unique Sequential Disconnecter

A unique Sequential Protection System ensures that each individual element can be disconnected from the circuit at the end of its life.

Security and Reliability

The CLMD capacitor is equipped with discharge resistors and is ready for installation.

Ease of Installation

The two slots allow easy and speedy installation.

Description

The ABB CLMD capacitors consist of a number of wound elements made with a dielectric of metallised polypropylene film. These dry windings are provided with a Sequential Disconnecter ensuring that each element can be reliably and selectively disconnected from the circuit at the end of its life. They receive a treatment under a vacuum in order to ensure perfect electrical characteristics. Each winding is placed in a plastic case and encapsulated in thermosetting resin in order to obtain a perfectly sealed element.

The elements are placed inside a sheet steel box and connected in such a way as to supply the single or three phase power at the required voltage and frequency.

The sheet steel box is filled with inorganic, inert and fire proof granules in order to absorb the energy produced in case of a possible defect at the end of an elements life. The CLMD units are also provided with thermal equalisers to ensure effective heat dissipation.

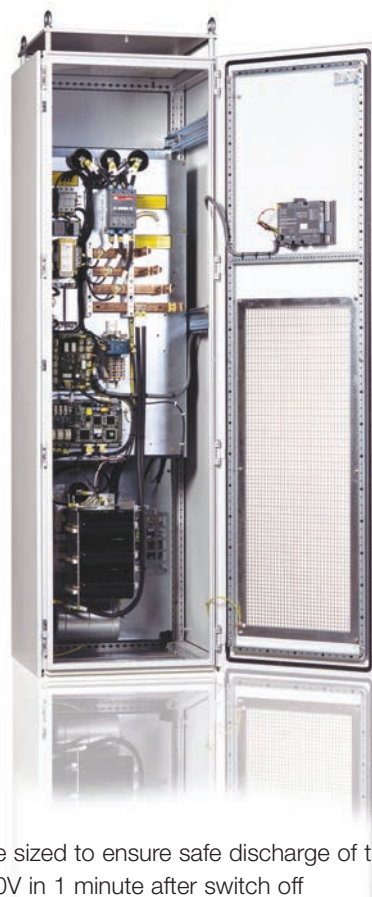
Technical Specifications:

Voltage range: From 380V-525V standard

Frequency: 50Hz standard

Connection: 3-phase as standard (single phase on request)

Discharge resistors: Permanently connected built-in discharge



resistors are sized to ensure safe discharge of the capacitor to less than 50V in 1 minute after switch off

Terminals: Threaded, M6 to M12 according to power of the capacitor

Earth: An M8 terminal is included. (M6 on CLMD14)

Cable Input: By customer

Case Material: Mild steel

Colour: Light Grey RAL7032

Fixing: With two slots

Location: Well ventilated indoor (outdoor on request)

Protection: IP42 (IP54 on request)

Maximum Ambient Temperature: +50°C Class "D" according to IEC831

Minimum Ambient Temperature: - indoor: -25°C, outdoor: -40°C

Minimum Distance Between Units and Wall: 50mm (recommended)

Losses: (Discharge resistors included): Less than 0.5 Watt/kVAR

Tolerance on Capacitance: -5% + 15%

Voltage Test:

– between terminal: 2.15 Un for 10 seconds

– between terminals and earth: 3kV for 10 seconds

The acceptable overloads are those specified in IEC 831 – 1&2:

– overvoltage tolerance: 10% max. at intervals

– overcurrent tolerance: 30% continuously

– maximum overload: stable operation at 135% of the normal rating (generated by overvoltage and harmonics)

IMPORTANCE NOTICE

The installation of capacitors on networks disturbed by harmonics may require special precautions, especially when there is a risk of resonance.

Type	Rating (KVAR) 415V 50Hz	400V 50Hz	Terminal M	Weight Packed (KG)
CLMD 14	0.9*	0.83	16mm block	2.5
	1.4 *	1.3	" "	2.5
	2.0 *	1.8	" "	2.5
	2.7	2.5	" "	2.5
* star connected	4.2	3.9	" "	2.5
** 480 Volt Dielectric	5.5	5.0	" "	2.5
*** Only available To IPOO	6.2 8.5	5.7 8.0	" "	2.5
	10.0**	9.3	" "	2.5
	11.0	10.0	" "	2.5
	12.5	12.0	" "	2.5
	16.3***	15.0	" "	2.5
CLMD43	16.0	15.0	M6	4.5
	21.0	19.5	M6	5.0
	22.0	20.0	M6	5.0
	25.0	23.0	M6	5.5
	27.0	25.0	M6	5.5
CLMD53	30.0	26.0	M8	9.0
	32.0	30.0	M8	9.0
	37.5	35.0	M8	10.0
	43.0	40.0	M8	11.0
	50.0	45.0	M8	11.5
CLMD63	54.0	50.0	M10	15.5
	65.0	60.0	M10	17.0
	75.0	70.0	M10	18.0
	86.0	80.0	M12	23.0
CLMD83	90.0	84.0	M12	25.0
	100.0	93.0	M12	25.0
	110.0	100.0	M12	25.0
	130.0	120.0	M12	27.0

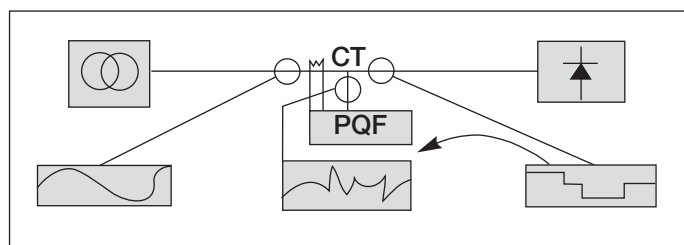
Reduction of Harmonic Distortion

There are 2 effective ways to reduce or eliminate harmonic currents on an electrical system. These are Passive and Active Filters.

Passive Filters in their basic form comprise a capacitor connected in series with a reactor tuned to the frequency to be eliminated. In theory the impedance of the filter is zero and therefore all of the particular harmonic current is absorbed by the filter. In practice however, the capacitor and reactor are usually tuned slightly below the harmonic frequency. This together with the natural resistance of the circuit means that only a small acceptable level of harmonic current will flow in the network. When it is necessary to reduce more than one harmonic a multi arm filter may be required.

Passive filters are used where the system has sufficient inductive kvar to be compensated by the capacitor within the filter and where a cost effective solution to reactive power compensation and filtering is required.

The principle of Active Filtering is fundamentally different from that of the passive filter. The passive filter is not controlled and the filtering is a result of the impedance characteristics of the system. The active filter instead measures the harmonic currents and generates actively a harmonic current that was measured. The original harmonic currents are thereby cancelled. The principle is shown in the diagram.



Load Alteration

Whenever load expansion is considered, with or without additional power factor correction equipment, the network impedance is likely to change and existing filter equipment must be re-appraised in conjunction with the new load condition and be suitably uprated. It is not recommended to have two or more filters fine tuned to the same busbar system. Slight tuning differences may cause one filter to take a much larger share of the harmonic distortion, or even cause a harmonic resonance condition leading to amplification of the very harmonic order for which the equipment has been designed to reduce. When there is a need to vary the power factor correction component of a harmonic filter, careful consideration of all parameters is necessary.

Active Filters offer considerable flexibility for load expansion or where the nature of the load is likely to change. The levels of harmonic current reduction can be reselected to suit new parameters and with the modular construction used in ABB PQF Active Filters additional power modules can be added to the system for more harmonic current elimination. The active filter can be used for loads that have high power factor and is programmable for changing loads. ABB have a wealth of experience in designing, manufacturing and supply filter systems of both passive or active types and hybrid solutions embodying both technologies for cost efficient reactive power compensation and reduction of harmonic distortion.

Harmonic Analysis

To determine capacitor and filter requirements to meet specific harmonic conditions, it is necessary to establish with accuracy the impedance of the supply network and the value of each harmonic current experienced at the point of intended connection of any filter or power factor correction capacitor. ABB is the leading manufacturer and supplier of Harmonic Filter Systems at all voltages. Site analysis and scheme design are undertaken on an individual basis to utilise our technical expertise to the best advantage of our customer in each case.

Information Required

In considering the application of power factor correction equipment where harmonics are evident or suspected, detailed site information will assist design of the most economic and technically acceptable scheme.

Such information should always include:

- Simplified line diagram of system
- Supply Transformer(s) rating and impedance
- Summary of system load including
- Source of harmonics (AC Drives-DC Drives)
- Type of harmonic generating equipment (e.g. 6 pulse)
- Details of additional proposed harmonic current generating equipment
- Ratings of existing capacitors
- Rating of proposed power factor correction capacitors

Type Tested Assemblies

Introduction to Type-Tested & Partially Type-Tested Assemblies

IEC 60439-1-1999-09, EN60349-1 and BS EN60439-1 is part 1 of the 439-series of standards and is the main part covering the general requirements for type-tested assemblies.

Parts 2, 3, and 4 of the standards deal with the particular requirements for certain specialised forms of assemblies (see below).

Low-voltage switchgear and controlgear assemblies

- 439-1: Specification for type-tested and partially type-tested assemblies.
- 439-2: Particular requirements for busbar trunking systems.
- 349-3: Particular requirements for assemblies intended to be installed where unskilled persons have access to their use.
- 439-4: Particular requirements for assemblies for construction sites.

The need to conform to standards

Low-voltage switchgear and controlgear come under the EU Low Voltage Directive, and since January 1st 1997, all new assemblies intended for use within the EU member states must be CE-marked to indicate that they conform with the essential safety requirements of this Directive.

The Directive requires electrical equipment to be safe and constructed in accordance with the principles generally accepted within the member states of the EU as constituting good engineering practice in relation to safety matters. It requires that the electrical equipment (assembly), together with its components, is made in a way that ensures it can be safely and properly assembled and connected. It also requires that measures are taken to ensure that protection is assured against various hazards which might arise from the electrical equipment or by external influences on it.

Some of the hazards listed by the directive include:

- Direct and indirect contact with live parts
- Dangerous temperatures, arcs or radiation
- Overloading
- Insulation failures
- Mechanical failures
- Expected environmental conditions
- Non-electrical dangers caused by the assembly

There is, of course, the proviso that an assembly is used in an application for which it was made, and that it is properly installed.

Type-Tested Assembly (TTA)

IEC 60439-1-1999-09 CLAUSE 2.1.1.1

A low-voltage switchgear and controlgear assembly conforming to an established type or system without deviations likely to significantly influence the performance, from the typical assembly verified to be in accordance with this standard.

Notes:

For various reasons, for example transport or production, certain steps of assembly may take place outside the factory of the manufacturer of the TTA. Such an assembly is considered as a TTA provided the assembly is performed in accordance with the manufacturers instructions in such a manner that compliance of the established type or system with this standard is assured, including submission to applicable routine test.

Partially Type-Tested Low-Voltage Switchgear & Controlgear assembly (PTTA) IEC 60439-1-1999-09 Clause 2.1.1.2

A low-voltage switchgear or controlgear assembly, containing both type-tested and non-type-tested arrangements provided that the latter are derived (e.g. by calculation) from type tested arrangements which have complied with the relevant tests.

Enclosure & Distribution Systems



Our Range:

Thanks to our innovative products, ABB has become the leading manufacturer of electrical distribution systems found on the market today. We develop and produce custom electrical distribution systems for all types of buildings including domestic, commercial and industrial. All our systems are fully type tested to national and international standards.

MNS:

MNS Fully Type Tested Switchgear Assemblies (TTA) up to 6300A and up to IP54, Special Colours, Fixed or Withdrawable for distribution and motor control centres.

Striebel & John:

A comprehensive range of electrical distribution systems covering consumer units surface and flush, wall and floor standing systems up to IP54 and Fire Protection Cabinets. Form 4 Tri Line-R TTA up to 4000A.

Smissline:

A Plug in distribution system rated up to 200A. Rated up to IP54 in wall and floor standing systems.

MCB Pan Assembly:

A range of Pan Assembly Systems for miniature circuit breaker applications up to 250A incoming. A full and comprehensive range of incoming and outgoing devices and accessories are available, side, top and bottom extension boxes.

MCCB Pan Assembly:

A full and comprehensive range of TTA systems in MCCB arrangements. Incoming devices up to 800A and outgoing devices from 10A up to 630A. Customised to customer requirements.

Mirage Pan Assembly:

A 50KA miniature circuit breaker Pan Assembly TTA. Incoming devices up to 630A, outgoing devices MCB's up to 125A 50KA.

Turati Sub & Main Distribution:

A full range and comprehensive range of sub and main distributions wall and floor standing TTA from 100A up to 4000A. ArTu K, L & M. IP rated up to IP65.

Turati Automation Enclosures:

A full range and comprehensive range of wall and floor mounted enclosures in wall, floor standing, control consoles and 19" rack systems for all control application areas. Rated up to IP65. There are also a full and comprehensive range of accessories available.

Luca Plastic Enclosure Systems:

A full range and comprehensive range of plastic enclosures for distribution and control application for domestic, commercial and industrial applications. IP rated up to IP65.

Kabeldon IP Systems:

IP distribution system for outdoor applications up to 1600A incoming and outgoing up to 630A. Enclosures are hot dip galvanised and fully TTA to IEC standards and Arctic weather conditions.

Forms of Separation

Forms of Separation			
Main criteria	Sub-criteria	Form	Type of construction
No separation		Form 1	
Separation of busbars from the functional units.	Terminals for external conductors not separated from busbars.	Form 2a	
	Terminals for external conductors separated from busbars.	Form 2b	Type 1 Busbar is achieved by insulated covering, e.g. sleeving, wrapping or coatings.
			Type 2 Busbar separation is by metallic or nonmetallic rigid barriers or partitions.
Separation of busbars from the functional units and separation of all functional units from one another.	Terminals for external conductors not separated from busbars.	Form 3a	
Separation of the terminals for external conductors from the functional units, but not from each other.	Terminals for external conductors separated from busbars.	Form 3b	Type1 Busbar separation is achieved by insulated coverings, e.g sleeving, wrapping or coatings.
			Type 2 Busbar separation is by metallic or nonmetallic rigid barriers or partitions.
Separation of busbars from the functional units and separation of all functional units from one another, including the terminals for external conductors which are an integral part of the functional unit.	Terminals for external conductors in same compartment as associated functional unit.	Form 4a	Type 1 Busbar separation is achieved by insulated coverings, e.g. sleeving, wrapping or coatings. Cables may be glanded elsewhere.
			Type 2 Busbar separation is by metallic or nonmetallic rigid barriers or partitions Cables may be glanded elsewhere.
			Type 3 Busbar separation is by metallic or non-metallic rigid barriers or partitions. The termination for each functional unit has its own integral glanding facility.
	Terminals for external conductors not in the same compartment as the associated functional unit, but in individual, separate, enclosed protected spaces or compartments.	Form 4b	Type 4 Busbar separation is achieved by insulated coverings, e.g. sleeving, wrapping or coatings. Cables may be glanded elsewhere.
			Type 5 Busbar separation is by metallic or nonmetallic rigid barriers or partitions. Terminals may be separated by insulated coverings and glanded in common cabling chamber(s).
			Type 6 All separation requirements are by metallic or non-metallic rigid barriers or partitions. Cables are glanded in common chamber(s).
			Type 7 All separation requirements are by metallic or non-metallic rigid barriers or partitions. The termination for each functional unit has its own integral facility.

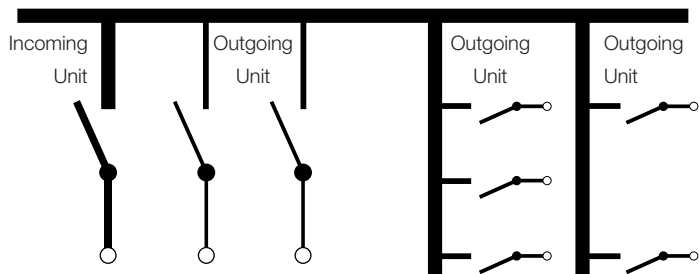
Form 1 Requirements

Form 1 covers overall Assemblies which are enclosed so as to provide protection against contact with any internal live parts or components, but where no internal separation is provided for functional units or terminations.

For Form 1

- i) Busbars are not separated from the functional units.
- ii) Functional units are not separated from other functional units.
- iii) Functional units are not separated from any incoming or outgoing termination.
- iv) Busbars are not separated from any incoming or outgoing terminations.

Form 1



Form 2 Requirements

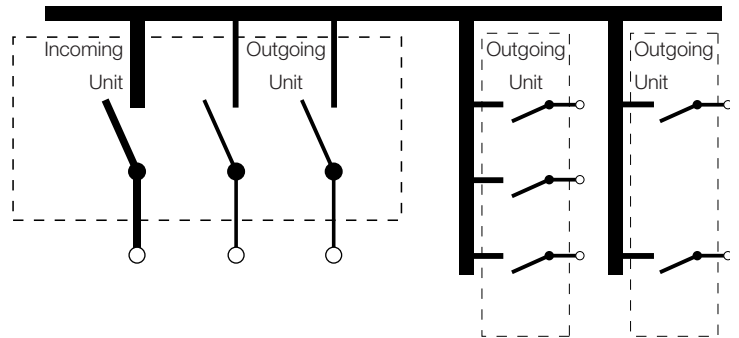
Form 2 defines overall Assemblies which are enclosed to provide protection against contact with any internal live parts or components, and where there is internal separation of the busbars from functional units. The following general conditions apply;

- i) Busbars are separated from functional units.
 - ii) Functional units are not separated from other functional units.
- Compliance with the requirements of Form 2 may be offered by EIEMA manufacturers by any of the three methods. Specifiers and Users should clearly state their preference.

Form 2 (form 2a)

Basic form as a above. However, with this method terminals are not separated from the busbars, or each other. The actual means of separation is not defined in the standard.

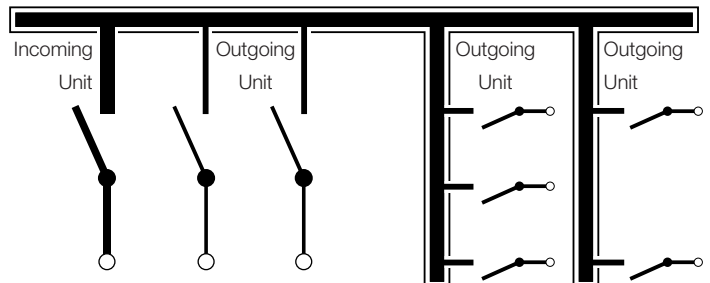
Form 2a



Form 2 Type1 (form 2b type 1)

Main criteria as Form 2. Busbar separation is achieved by insulated coverings, e.g. PVC sleeving, wrapping or coating. Terminals are therefore separated from the busbars, but not from functional units or each other.

Form 2b



Form 2 Type 2 (form 2b Type 2)

Main criteria as Form 2. Busbar separation is achieved by metallic or non-metallic rigid barriers or partitions. Terminals are therefore separated from the busbars, but not from the functional units or each other.

Form 3 Requirements

Form 3 defines overall Assemblies which are enclosed to provide protection against contact with internal live parts and components, and in which there is internal separation of all functional units from each other.

The following general conditions apply;

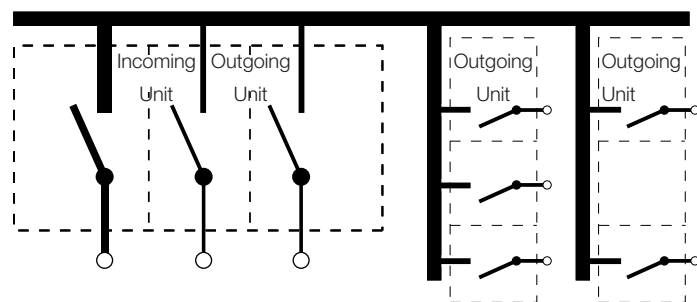
- i) Busbars are separated from functional units.
- ii) Functional units are separated from each other.
- iii) Functional units are separated from incoming and outgoing terminals.
- iv) Incoming and outgoing terminals are not separated from each other.

Compliance with the requirements of Form 3 may be offered by EIEMA manufacturers by any of the three methods. Specifiers and users should clearly state their preference.

Form 3a

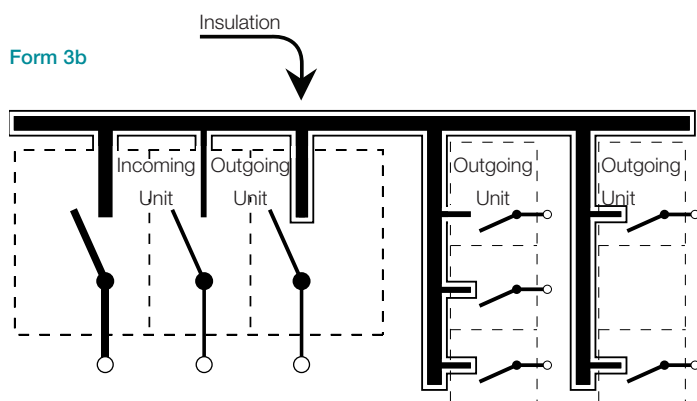
Basic form as above. Terminals are not separated from the busbars or each other. The actual means of separation is not defined in the Standard.

Form 3a



Form 3b Type 1

As basic Form 3. Busbar separation is achieved by insulated coverings, e.g. PVC sleeving, wrapping or coating. Terminals are therefore separated from the busbars, but not from each other.



Form 3b Type 2

As basic Form 3. Busbar separation is achieved by metallic or non-metallic rigid barriers or partitions. Terminals are therefore separated from the busbars, but not from each other.

Form 4 Requirements

Form 4 covers overall Assemblies which are so enclosed as to provide protection against contact with internal live parts and components, and in which there is internal separation of the busbar system from functional units, and separation of all functional units from each other. Incoming and outgoing terminals are also required to be separated from the busbars and from each other.

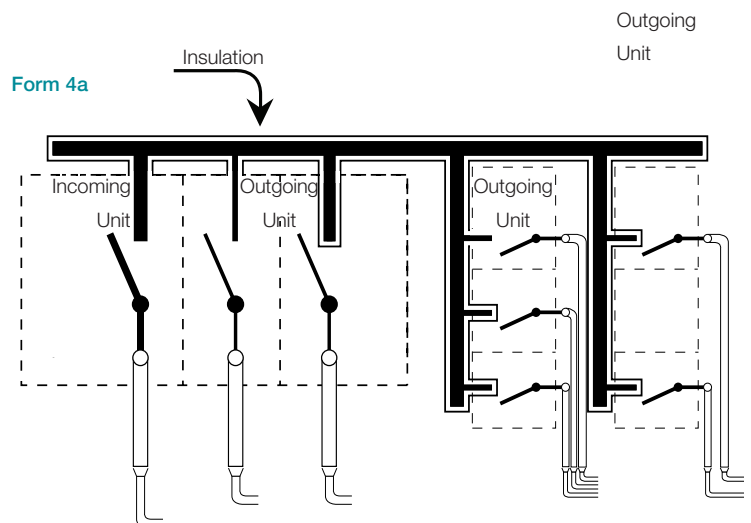
The following general conditions apply;

- i) Busbars are separated from functional units.
- ii) Functional units are separated from each other.
- iii) Terminations to functional units are separated from each other.

Compliance with any of the requirements of Form 4 may be offered by EIEMA manufactures by any of the following seven methods. Specifiers and users should clearly indicate their preference.

Form 4 Type 1(form 4a type 1)

As basic Form 4. Busbar separation is achieved by insulated coverings, e.g. PVC sleeving, wrapping or coating. Cables are terminated within the same compartment as the associated functional unit. Cables may be glanded elsewhere, e.g. in a common cabling chamber.



Form 4 Type 2 (Form 4a Type 2)

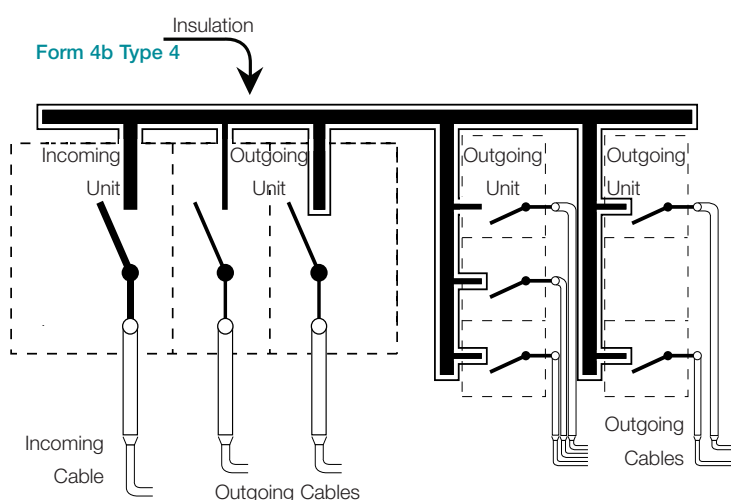
As basic Form 4. Busbar separation is achieved by metallic or non-metallic rigid barriers or partitions. Cables are terminated within the same compartment as the functional unit. Cables may be glanded elsewhere, e.g. in a common cabling chamber.

Form 4 Type 3 (Form 4a Type 3)

As basic Form 4. Busbar separation is achieved by metallic or non-metallic rigid barriers or partitions. Cables are terminated within the same compartment as the functional unit. The termination for each functional unit has its own integral glanding facility.

Form 4 Type 4 (Form 4b Type 4)

As basic Form 4. Busbar separation is achieved by insulated coverings, e.g. PVC sleeving, wrapping or coating. Terminals are extended to the functional unit and separated by insulated coverings, e.g. PVC boots. Cables may be glanded elsewhere, e.g. in a common cabling chamber.



Note: Where connections between the terminals and the functional unit pass through the same general compartment as the busbar, busbar separation may be achieved by insulated covering of these connections only.

Form 4 Type 5 (Form 4b Type 5)

As basic Form 4. Busbar separation is achieved by metallic or non-metallic rigid barriers or partitions. Terminals are external to the functional unit compartment and separated by insulated coverings, e.g. PVC boots. Cables may be glanded elsewhere, e.g. in a common cabling chamber.

Form 4 Type 6 (Form 4b Type 6)

As main criteria for Form 4. All separation is achieved by metallic or non-metallic rigid barriers or partitions. Terminals are external to the functional unit compartments and enclosed in their own compartment by means of rigid barriers or partitions. Cables may be glanded elsewhere, e.g. in a common cabling chamber.

Form 4 Type 7 (Form 4b Type 7)

As main criteria for Form 4. All separation requirements are achieved by metallic or non-metallic rigid barriers or partitions. Terminals are external to the functional unit compartment and enclosed in their own compartment by the means of rigid barriers or partitions complete with integral glanding facility.

IP Ratings

As indicated in the following table, the IP degree of protection is expressed by two characteristic numbers depending on the

behaviour of the product to which it refers according to the prescriptions of CEI 70-1 and IEC 60529 Standards.

First number: protection against the penetration of solid bodies	Second number: protection against the penetration of water	Additional Letter
IP	IP	Letter
0 No protection	0 No protection	
1 Protection against the penetration of solid bodies with a diameter of over 50mm	1 Protection against the penetration of drops of water falling vertically	A Protected against access with the back of the hand
2 Protection against the penetration of solid bodies with a diameter of over 12mm or a length of over 80mm	2 Protection against the penetration of drops of water falling at an angle of up to 15° from vertical	B Protected against access with a finger
3 Protection against the penetration of solid bodies with a diameter or thickness of over 2.5mm	3 Protection against the penetration of drops of water falling at an angle of up to 60° from vertical	C Protected access with a tool
4 Protection against the penetration of solid bodies with a diameter or thickness of over 1.0mm	4 Protection against the penetration of splashes of water from all directions	D Protected access with a wire
5 Protection against the penetration of dusts	5 Protection against the penetration of water sprayed by a hose from all directions	
6 Total protection against the penetration of dusts	6 Protection against the penetration of sea water	
	7 Protection against the penetration of water during temporary immersion	
	8 Protection against the penetration of water during continual immersion	

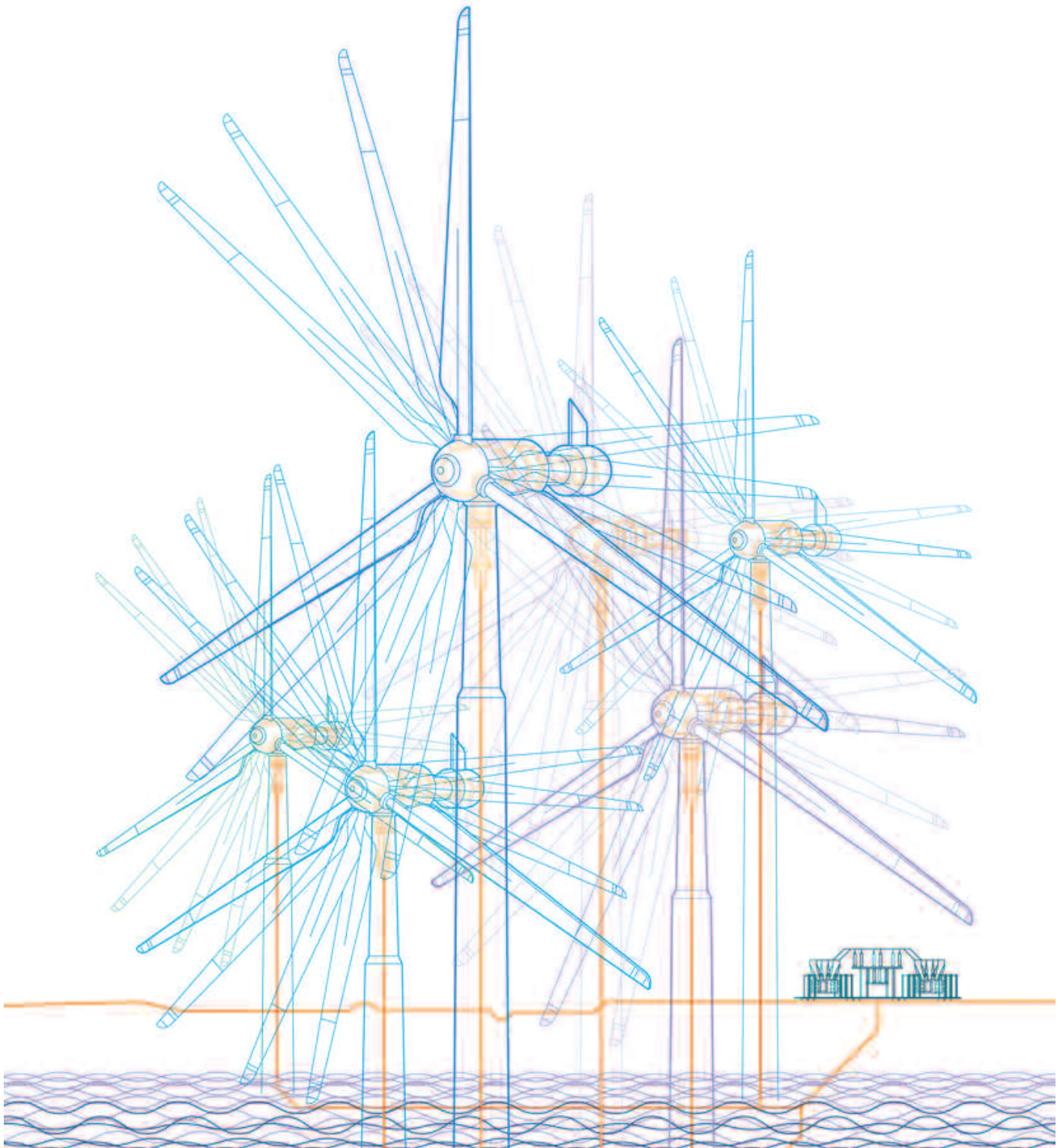


ABB – the biggest supplier of electrical components, systems and services to the wind power industry

Experience plays an important role when customers choose ABB for their products, systems and services. Over 100 years of experience and collaboration with power utilities, the process and automation industry and OEMs enables ABB to convert know-how and application understanding into products and solutions to benefit the wind power industry. Sustainable solutions, reliability and knowledge of industry-specifics, such as grid codes, have made ABB the leading partner for wind power.

ABB – present where you are

ABB is close to its customers everywhere in the world. Our global presence offers customers easy access to leading electrical engineering products, systems and services everywhere in the world.

Innovation and quality, the key characteristics of our offering, are reinforced by our knowledge and understanding of local requirements and needs, and of local manufacturing, service and logistics. ABB companies operate in around 100 countries and employ about 110,000 people.

Grid code knowledge for power quality, grid stability and improved control

Grid codes have existed for decades, mainly as national regulations for connecting all types of large power generators to AC grids. The grid manages the reactive power supply to keep the grid voltage within operational limits and recover voltage immediately after a fault. Wind power generation, from large wind farms as well as a number of small turbine groups, now supply hundreds of megawatts to several regional AC power grids. The international harmonisation of national grid codes to accommodate the growing contribution of renewable energy generated from wind is ongoing. ABB supplies its customers with a variety of solutions and also participates in many international groups addressing grid code issues.

Reactive Power Compensation

With advanced power electronics, ABB offers STATCOM system knowledge. With its selection of compensator products such as PCS6000, SVC Light® and SVC, ABB also offers expertise for implementing the functions for connecting wind farms to the grid. FACTS is an acronym for flexible AC transmission systems. ABB's systems based on power electronics offer dynamic reactive power compensation based on voltage source converter technology. The solutions offer farm operators fast control, continuous compensation, low harmonics and low costs with increased efficiency.

Grid code compliant converters

Converters, both low and medium voltage, are based on premium frequency converter technology and are grid code compliant. They can be single turbine installations with virtual direct-torque-control towards the grid. Our converters ensure continuous operation even during times of grid fault. The converter control principle enables fast control, robustness, increased availability and a high quality of generated power. For wind farms and their reactive power compensation, we offer two STATCOM solutions, depending on the ratings. PCS6000 and SVC Light® are products based on, and equipped with, pulse-width-modulated control. They are particularly well adapted to enhance grid code compliance of wind power applications on a large scale. Power stations are now built and operated by a growing number of wind farm developers, increasing the supply of wind-derived electricity.

Grid connections in remote areas

ABB's HVDC Light® underground transmission system offers reliable grid connection and can be connected to any type of wind power concept

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