ABBACUS
Metal Enclosed Capacitor Bank

Power and productivity
for a better world™

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1. Introduction

ABBACUS Metal Enclosed Capacitor Bank

ABB is the world's leading capacitor manufacturer. This competence has led to a fully integrated ABB solution known as ABBACUS, for reactive compensation in medium voltage networks.

The ABBACUS combines primary components, and secondary control and protection, within a compact modular enclosure. The system can be either configured as a fixed or switched capacitor bank. The switched bank consists of single or multiple steps, automatically controlled to improve power factor.

IP31 MILD STEEL INDOOR ENCLOSURE

The design of the ABBACUS provides compensation for both electrical distribution utilities and large industrial power users including mining, pulp and paper, chemical, petrochemical, wind farms, plastics and heavy industry.

The ABBACUS is available in a range of MECB (Metal Enclosed Capacitor Bank) models and is suitable for voltage ranges between 1 kV and 24 kV. For higher voltages contact ABB.

The ABBACUS is assembled and factory tested in an ISO 9001 and ISO 14001 environment.

IP44 ALUMINIUM INDOOR/OUTDOOR ENCLOSURE

2. Features and Benefits

What does ABBACUS offer?

ABB has utilised its extensive experience both in component design and application engineering to design a superior solution. The ABBACUS offers the flexibility through its modular approach to meet the varying requirements and specifications of utility and industrial users.

The ABBACUS is a smart solution which aims to fulfill the needs identified through an extensive customer survey.

These needs are addressed in some of the benefits the ABBACUS offers;

- Reliability and Performance
- Commercial
- Safety
- Flexibility
- Easy to Use
- Real Estate Saving

A features and benefits analysis is outlined below.

Feature	Benefit
ABB's experience and knowledge ABB's premium range of components – Consistency of quality – Proven technology – Leading capacitor manufacturer – Type tested solution Factory tested Integrated design of primary and secondary equipment Durable aluminium enclosure suitable for a variety of applications Reduces operating costs	**Reliability and Performance**
Reduces operating costs Tangible return on investment Proven ABB design reducing life cycle costs	**Commercial**
Fully enclosed design protecting live parts Safety levels ranging from pad lockable doors through to interlocking with upstream devices Explosion venting in each module	**Safety**
Modular in design Expandable design to meet the needs of increased plant load Relocatable asset, can be moved as plant demands change	**Flexibility**
Maximise factory assembly – minimise plant down time – simple installation Ease of handling	**Easy to use**
Compact design	**Real estate saving**

3. Power Factor

3.1 Why improve power factor?

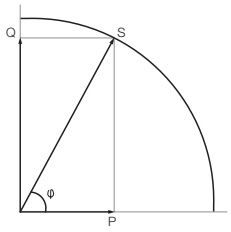
– Reduce electricity charges
– Reduced energy losses
– Increase network capacity
– Economically plan new electrical infrastructure
– Reduce voltage drop
– Reduce the effects of starting large machines

3.2 How do you improve power factor?

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

Figure 1: Uncompensated Load

$\cos \varphi = \frac{P}{S}$ $\sin \varphi = \frac{Q}{S}$ $\tan \varphi = \frac{Q}{P}$

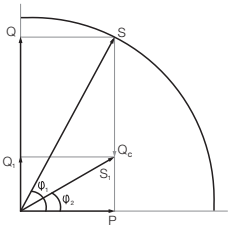


Shows the relationship between apparent (S), active (P) and reactive power (Q) at a certain power factor (cos ϕ) of the load. The load is uncompensated and if the conductor or the transformer is fully loaded the arc of the circle defines the maximum power output.

Figure 2: Compensated Load

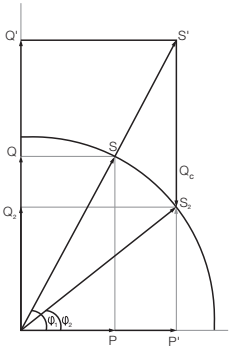
$Q_c = P (\tan \varphi_1 - \tan) \varphi_2$

$\tan \varphi = \sqrt{\frac{1}{\cos^2 \varphi} - 1}$



Shows the reactive output (Q) from the power supply network reduced by the capacitor output (Q_c) to (Q_1) when applying power factor correction. The total load on the power supply network is reduced from (S) to (S_1) at an unchanged active power output.

Figure 3: Compensated Load where the load is increased



With the capacitor in service additional machines now may be connected, ie the load may be increased. Figure 3 shows an increase of active load from (P) to (P'). The capacity of the conductor or the transformer is fully utilised when (S_2) equals (S).

3.3 Where to use power factor correction

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

Central Compensation

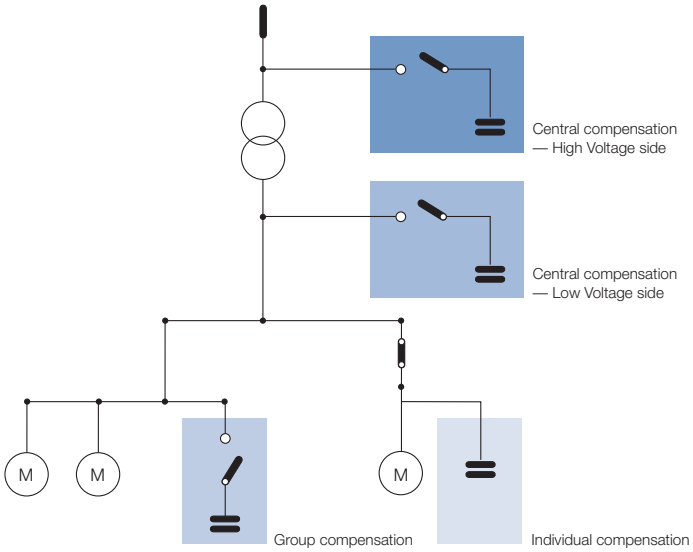
When the main purpose is to reduce reactive power purchased, due to power supplier's tariffs, central compensation is preferable.

Group Compensation

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

Individual Compensation

The special advantage with individual compensation is that existing switching and protective devices for the machine to be compensated can also be utilised for switching and protection of the capacitors.



3.4 Harmonics

Harmonics are an important aspect when considering power factor correction. The ABBACUS range includes a number of options to overcome the effects of these harmonics.

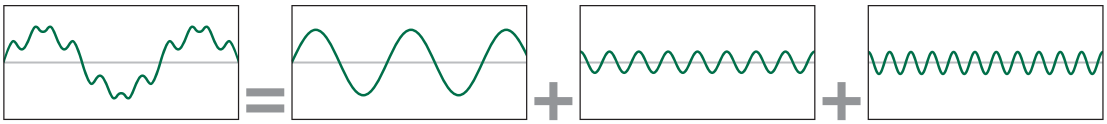
Modern electrical equipment consists of nonlinear devices which generate harmonics. Examples of these devices include the following:

- Equipment containing electronics that control other apparatus, eg variable speed drives, soft starters, static compensators, rectifiers, etc
- Arc furnaces
- In certain cases, transformers, reactors and rotating machines
- Domestic appliances.

Harmonics are not only found in industrial networks, they can also spread into the distribution network and cause problems for other power users. Common problems that harmonics can produce include:

- Overloading of capacitors, leading to malfunctioning and premature aging
- Increased losses, eg machines will operate at increased temperatures
- Resonance problems between the inductive and capacitive parts of the network
- Malfunctioning of control systems
- Interference with telecommunication and computer equipment
- Disturbances in ripple control systems
- High currents in neutral conductors.

Harmonics distort the sine wave (50 Hz or 60 Hz signal) which becomes apparent when a distorted sine wave is mathematically analysed. The example below shows that the distorted wave consists both of the fundamental frequency (eg 50 Hz) and super-imposed 5th (250 Hz) and 7th (350 Hz) harmonic frequencies.



3.5 Resonance

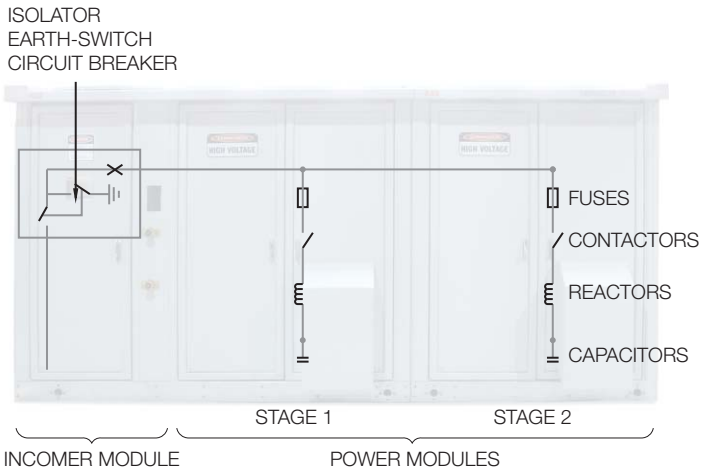
Resonance can be a problem when capacitors for power factor correction are applied to networks with nonlinear loads that inject harmonic currents. With the ABBACUS solution this is no longer a problem.

Resonance is a special network condition in which the inductive reactance is equal to the capacitive reactance. All circuits have a resonant condition at some particular frequency, known as the natural frequency of the circuit.

Capacitors may lower the resonant frequency of a network enough to create a resonant condition with the harmonic currents. As resonance is approached, the magnitude of harmonic current in the network and capacitor becomes much larger than the harmonic current generated by nonlinear loads. The higher current may be sufficient to damage capacitors.

A solution to this problem is to tune the circuit away from the resonant frequency. Tuning away from this resonant frequency is often referred to as ‘detuning’.

4. Product Modularity



4.1 Single Line Diagram

The ABBACUS design will consist of an incoming module and/or connecting power modules housing the primary equipment with optional secondary and ancillary equipment kits. The ABBACUS design is modular allowing future expandability.

4.2 Incomer Module

The incomer module facilitates connection to the customer network. It comprises of a high voltage compartment and a control cubicle allowing for a single point termination of power cables and control wiring. (Refer to Section 5 for technical aspects of the key components.)

4.2.1 Control Cubicle

The Control Cubicle for the ABBACUS depending on the MECB series can accomodate the following options:

- Power factor controller
- Modbus communication
- Safety interlock keys
- Over current/earth fault protection relay
- Unbalance protection relay
- Unbalance/overload protection relay
- Under/overvoltage protection relay
- Local/remote and manual/automatic switching
- Alarm indication
  - power factor not reached
  - over temperature
  - over pressure
  - fuse failure.

4.2.2 High Voltage Section

The High Voltage Section for the ABBACUS range can according to the options selected accommodate the following:

- Incoming cable termination busbars
- Isolator/earth switch
- Surge arrestors
- Circuit breakers
- Protection voltage transformers
- Line current transformers
- Control voltage transformers
- Live line indication.

4.3 Power Module

The Power Modules in the ABBACUS when energised generate the reactive power. These modules are designed to be interconnected to each other and the incomer module. (For most models, refer to Section 6 for more detail). Using the ABBACUS selection tree seen in Section 6, an appropriate power module can be chosen depending on the required application. In addition, Section 6.2, ABBACUS Options Guide highlights the standard and optional features of each MECB model.

The Power Modules for the ABBACUS range can accommodate the following (see Section 5 for technical aspects of the key components):

- Capacitors
- Inrush reactors or detuning reactors
- HRC fuses
- Contactors
- Unbalance current transformers
- Rapid discharge voltage transformers
- Pressure switches
- Earthing stick
- Safety interlocks
- Lights
- Anti condensation heaters
- Connecting busbars
- Cable entry box
- Cooling fans
- Thermostats.

5. Key Components

ABB has invested significant research in to the design and specification of every key component in the ABBACUS to ensure maximum reliability and performance. A full list of technical specifications is available in Section 8.

5.1 The ABBACUS Enclosure

5.1.1 General

The ABBACUS enclosure is constructed from AA-grade corrosion resistant Aluminium mounted on a hot-dipped galvanized base frame.

Aluminium offers the following benefits:

- Suitable for applications across a wide range of ambient temperatures.
- Three times the thermal conductivity of steel and is able to transfer heat from within the enclosure. It also has high reflectivity to minimize the effects of solar radiation.
- No magnetic properties eliminating the risk of eddy-currents formed by closed magnetic loops.
- High strength-to-weight properties making it a light-weight enclosure design.

Design

The enclosure is designed and tested up to IP54, suitable for indoor and outdoor applications over a wide range of environmental conditions.

Safety

The enclosure is designed to exhaust hot gases safely away from the operator under fault conditions. This is achieved by having every module designed with roof vents to exhaust gases vertically up and door vents to direct hot gases vertically down away from personnel.

Handling

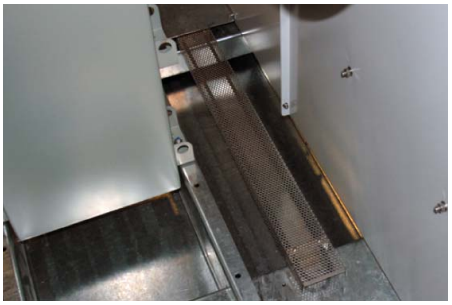
The enclosure base frame incorporates fork and crane lifting facilities. This assists with trouble-free handling and assembly of modules on site.

Note. ABBACUS models MECB 12 FI 00, 12 FI 01 and 12 SI 00 are manufactured using zinc-coated steel suitable for indoor IP31 applications only.

5.1.2 Internal Environment

Ventilation
The ABBACUS enclosure is designed and tested with a ventilation system up to IP54. The design incorporates natural convection or forced draft cooling according to the application.

Where natural ventilation is sufficient, the air is drawn in through door vents and exits through eave vents.



When the low-noise design cooling fans are fitted, the air passes through a synthetic fibre filter and is directed towards internal components. The air then discharges through door vents.

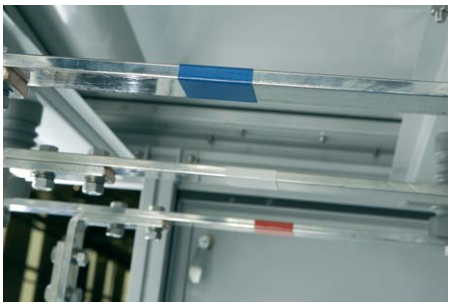
Anti-Condensation Heater
The ABBACUS enclosure is designed with anti-condensation heaters to assist in controlling the effects of fluctuating ambient temperatures and humidity.

5.1.3 Safety Interlocking

The ABBACUS range offers a mechanical/solenoid interlocking scheme. This eliminates the possibility of a technician accessing live equipment.

5.1.4 Busbars

The busbar support system used in the ABBACUS, is made from tinned copper, is mechanically rated to withstand an unconditional fault level of 25 kA and thermally rated to withstand 20 kA for 3 seconds.



5.2 Incomer Module

5.2.1 High Voltage Section

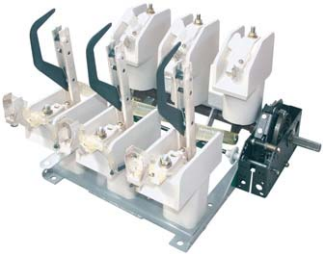


ABB Isolator/Earth Switch

The ABB NAL isolator and EB earth switch provides the capacitor bank with visual isolation from the incoming cables and general earthing for the capacitor bank. The isolator and earth switch, when used together are mechanically interlocked for safety.

ABB Circuit Breaker

The ABB VD4 circuit breaker is designed to protect medium voltage capacitor banks.

ABB Surge Arresters

The ABB MWD surge arrestors offer protection of medium voltage capacitor banks against multiple over voltage strikes. The maintenance free, explosion and shatter resistant design is stable against shock and vibrations.

ABB Voltage Transformers (Protection and/or control)

The ABB range of voltage transformers are designed to detect over/under voltages and provide a signal to a protection relay. The ABB TDC range of votage transformers provide a control voltage.

ABB Current Transformers (Protection)

The current transformers are designed to detect overcurrents in capacitor banks and provide a signal to a protection relay.

Live Line Indication

The ABBACUS is designed to accommodate live line indication to ensure the safety of operating personnel.

Door Micro Switches

The ABBACUS enclosure has been designed with door micro switches. This mechanism isolates the capacitor bank in the event that doors are opened while the equipment is live.

5.2.2 Control Cubicle

The ABBACUS design incorporates a fully integrated control and protection scheme using ABB's range of premium products.

ABB Power Factor Controller

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

The RVC is a user-friendly controller which includes the essentials required for automatic power factor control. The RVT offers a higher level of functionality including MODBUS communication, as well as monitoring and logging of network parameters.

ABB Protection Relays

The ABB SPAJ, SPAU and REU range of well-proven relays provide protection to meet the specific needs of capacitor banks.

5.3 Power Module

5.3.1 ABB Capacitors

The ABB capacitor unit type CHD is designed for heavy-duty operation in Fixed, Enclosed and Pole Mount Banks in all climatic conditions.

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

The ABB capacitor tank is constructed from a high-grade stainless steel providing excellent corrosion resistance. The seams are fully welded providing superior weld quality compared with other welding processes, resulting in virtually no risk of leakage. The ABB capacitors provide greater reliability and a longer service life.

ABB capacitors are offered in single, three or split phase designs depending on the application.

The ABB power capacitor is an all film design, with very low dielectric losses, low partial discharge, rsulting in an extended life time. Each capacitor has several elements that consist of a dielectric of polypropylene film and aluminium foil, which are connected in series and parallel groups, and star or delta connections depending on design.

The split-phase capacitor can be used in applications as an economic alternative. Three units can be used in a two-stage switched system, providing an economical and space saving alternative to utilising six conventional capacitors. Alternatively, it can be used as a dual tap capacitor or as a redundancy in critical applications.

ABB Pressure Switches

ABB capacitor units can be fitted with a pressure switch to provide a simple but effective means of isolation in the event of excessive pressures within the container.

The pressure switches are rated at 250V and set to 1 bar.

5.3.2 ABB Reactors

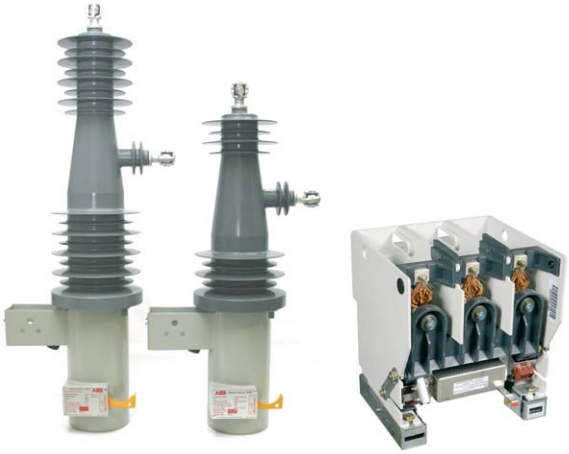
The ABBACUS is supplied with reactors, the type of which is determined by the application. The ABB reactors are designed and manufactured according to the highest standards to ensure maximum protection and lifespan of components.

Inrush Reactors

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

Detuning Reactors

Detuning reactors prevent series and parallel harmonic resonance which can occur when capacitors are connected to a network where high levels of harmonic currents are present. The reactors are tuned according to the application and are of an iron cored dry type design.



5.3.3 ABB Contactors and Switches

The ABB Contactors and Switches are designed and type tested for heavy duty capacitor switching.

ABB is the world leader in vacuum interrupter (VI) technology. The use of these VI's in ABB contactors and switches provides heavy duty switching and inceased life span.

5.3.4 ABB Protection

ABB HRC Fuses

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

Fuse Failure Indication

The fuse failure indicator can be fitted to provide the customer with indication of fuse operation under fault conditions.

ABB Current Transformers (Unbalance Protection)

The current transformers are designed to detect unbalanced currents in capacitor banks and provide a signal to a protection relay.

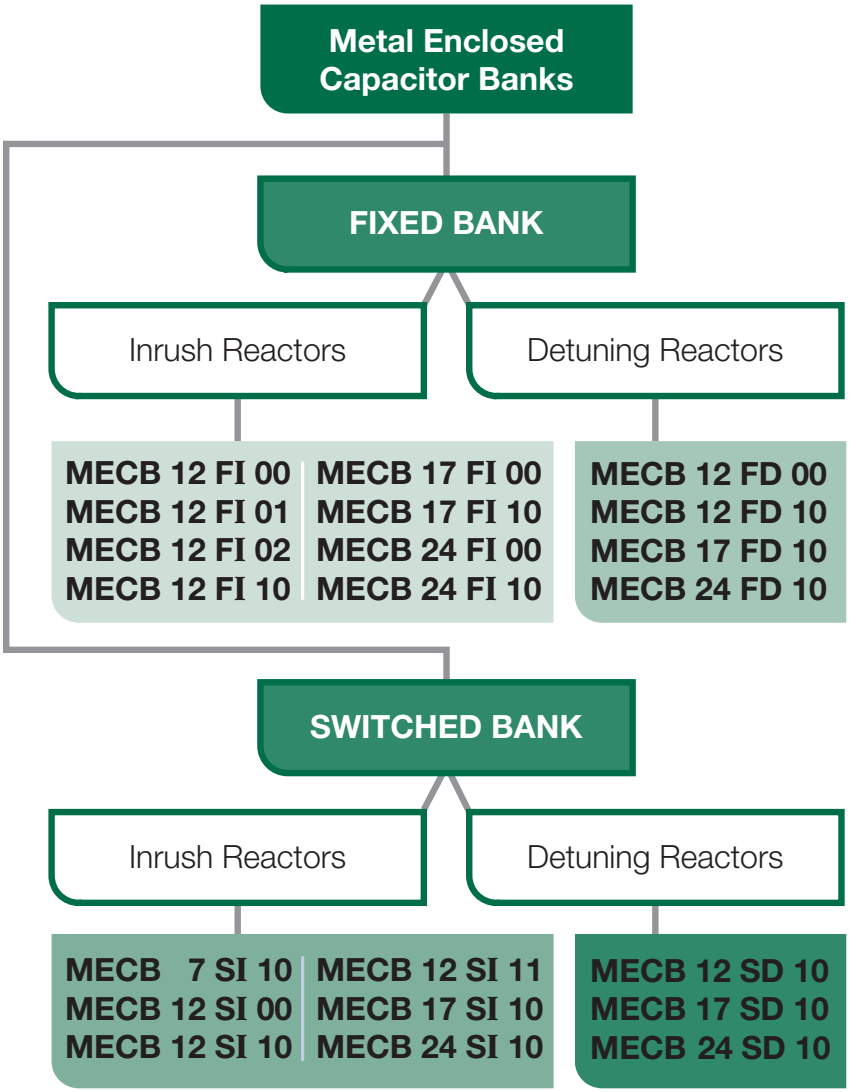
ABB Voltage Transformers (Rapid Discharge)

The ABB TDC range of voltage transformers are used for rapid discharge of capacitors.

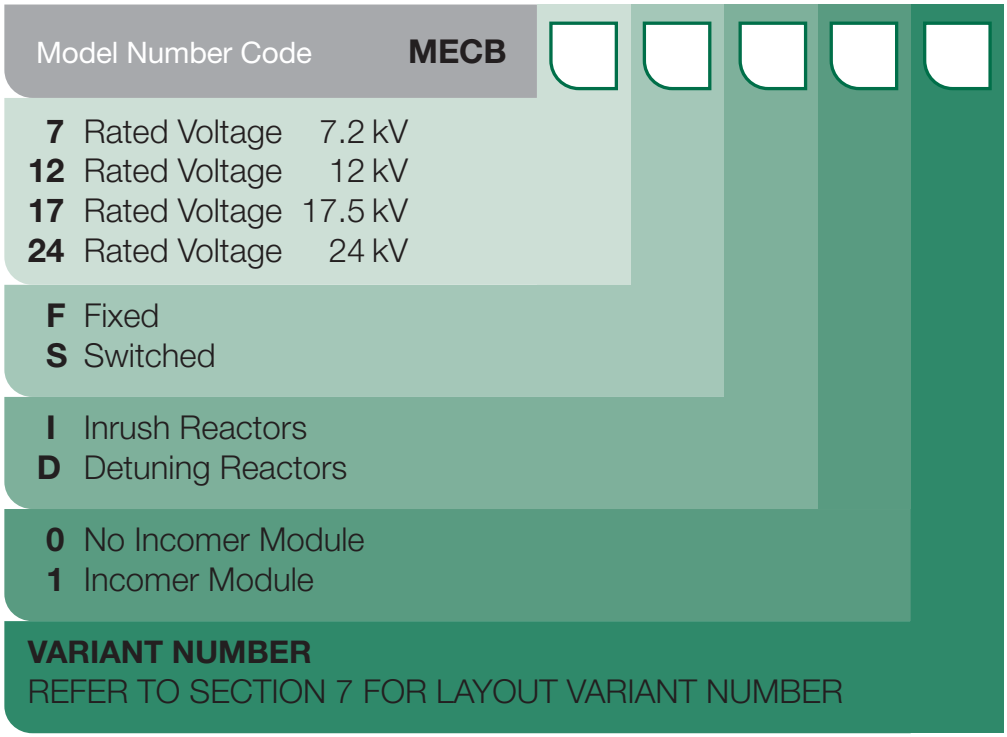
6. ABBACUS Selection Configuration

In selecting your MECB model, first decide whether the bank is fixed or switched. Secondly, decide on the type of reactor required. This then provides the model numbers you can select. The additional options/requirements will then define the exact model. Section 6.3 provides a table highlighting the list of standard features and the options for the models.

6.1 ABBACUS Selection Tree



6.2 ABBACUS Model Number Code



6.3 ABBACUS MECB Guide

FEATURE	MECB 12 FI 00	MECB 12 FI 01	MECB 12 FI 02	MECB 12 FI 10	MECB 17 FI 00	MECB 17 FI 10	MECB 24 FI 00	MECB 24 FI 10	MECB 7 SI 10	MECB 12 SI 00	MECB 12 SI 10	MECB 12 SI 11	MECB 17 SI 10	MECB 24 SI 10	MECB 12 FD 00	MECB 12 FD 10	MECB 17 FD 10	MECB 24 FD 10	MECB 12 SD 10	MECB 17 SD 10	MECB 24 SD 10
Enclosure General Details																					
Step Configuration																					
Fixed	S	S	S	S	S	S	S	S	–	–	–	–	–	–	S	S	S	S	–	–	–
Switched	–	–	–	–	–	–	–	–	S	S	S	S	S	S	–	–	–	–	S	S	S
Maximum Number of Switched Stages	–	–	–	–	–	–	–	–	4	4	4	4	4	4	–	–	–	–	4	4	4
*Step Size Power Mvar up to —	1	2	3.5	3.4	2.6	2.6	2.5	2.5	2.1	1	2.5	3.3	2.6	2.5	2.5	3.5	2.0	2.5	2.5	2.0	2.5
Reactor Type																					
Inrush	S	S	S	S	S	S	S	S	S	S	S	S	S	S	–	–	–	–	–	–	–
**Detuned 'P'=7%	–	–	–	–	–	–	–	–	–	–	–	–	–	–	S	S	S	S	S	S	S
IP Rating																					
IP 31	S	S	–	–	–	–	–	–	–	S	–	–	–	–	–	–	–	–	–	–	–
IP 44	–	–	S	S	S	S	S	S	S	–	S	S	S	S	S	S	S	S	S	S	S
IP 54	–	–	O	O	O	O	O	O	O	–	O	O	O	O	O	O	O	O	O	O	O
Indoor	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S
Outdoor	–	–	S	S	S	S	S	S	S	–	S	S	S	S	S	S	S	S	S	S	S
Voltage Range (kV)	≤12	≤12	≤12	≤12	>12 –17.5	>12 –17.5	>17.5 –24	>17.5 –24	≤7.2	≤12	≤12	≤12	>12 –17.5	>17.5 –24	≤12	≤12	>12 –17.5	>17.5 –24	≤12	>12 –17.5	>17.5 –24
Cubicle Floor	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S
Enclosure Material																					
Zinc Coated Steel	S	S	–	–	–	–	–	–	–	S	–	–	–	–	–	–	–	–	–	–	–
Aluminium	–	–	S	S	S	S	S	S	S	–	S	S	S	S	S	S	S	S	S	S	S
Safety Door Interlocks Key Release System																					
Electrical Signal	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O
Fortress Key	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O
Electrical Signal with Timer	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O
Incomer Module High Voltage Section																					
Incomer Module	–	–	–	S	–	S	–	S	S	–	S	S	S	S	–	S	S	S	S	S	S
Cable Entry Box	S	S	–	–	–	–	–	–	–	S	–	–	–	–	–	–	–	–	–	–	–
Incoming Cable Termination Busbars	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S
Isolator	–	–	–	O	–	O	–	O	O	–	O	O	O	O	–	O	O	O	O	O	O
Earth Switch	–	–	–	O	–	O	–	O	O	–	O	O	O	O	–	O	O	O	O	O	O
Surge Arrestors	–	–	–	O	–	O	–	O	O	–	O	O	O	O	–	O	O	O	O	O	O
Circuit Breaker	–	–	–	O	–	O	–	O	O	–	O	O	O	O	–	O	O	O	O	O	O
Protection VT	–	–	–	O	–	O	–	O	O	–	O	O	O	O	–	O	O	O	O	O	O
Over Current CT	–	–	–	O	–	O	–	O	O	–	O	O	O	O	–	O	O	O	O	O	O
Control Circuit VT	–	–	–	O	–	O	–	O	O	O	O	O	O	O	–	O	O	O	O	O	O
Live Line Indicators	–	–	–	O	–	O	–	O	O	–	O	O	O	O	–	O	O	O	O	O	O

* Please refer to Section 6.4 for the graphical representation of the Maximum Power Module Capacity

** For other 'P' values contact ABB

S Standard

O Optional

– Not Applicable/Not Available

FEATURE	MECB 12 FI 00	MECB 12 FI 01	MECB 12 FI 02	MECB 12 FI 10	MECB 17 FI 00	MECB 17 FI 10	MECB 24 FI 00	MECB 24 FI 10	MECB 7 SI 10	MECB 12 SI 00	MECB 12 SI 10	MECB 12 SI 11	MECB 17 SI 10	MECB 24 SI 10	MECB 12 FD 00	MECB 12 FD 10	MECB 17 FD 10	MECB 24 FD 10	MECB 12 SD 10	MECB 17 SD 10	MECB 24 SD 10
Incomer Module Control Cubicle																					
Power Factor Controller	–	–	–	–	–	–	–	–	O	O	O	O	O	O	–	–	–	–	O	O	O
Modbus Communication	–	–	–	–	–	–	–	–	O	O	O	O	O	O	–	–	–	–	O	O	O
Local/Remote Switching	–	–	–	–	–	–	–	–	O	O	O	O	O	O	–	–	–	–	O	O	O
Manual/Automatic Switching	–	–	–	–	–	–	–	–	O	O	O	O	O	O	–	–	–	–	O	O	O
Protection Relays																					
Unbalance	–	–	–	O	–	O	–	O	O	–	O	O	O	O	–	O	O	O	O	O	O
Unbalance and Overload	–	–	–	O	–	O	–	O	–	–	–	–	–	–	–	O	O	O	–	–	–
Over Current and Earth Fault	–	–	–	O	–	O	–	O	O	–	O	O	O	O	–	O	O	O	O	O	O
Over/Under Voltage	–	–	–	O	–	O	–	O	O	–	O	O	O	O	–	O	O	O	O	O	O
Unbalance Current Sensor	–	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O
Alarm Indication Signals (wired to contacts)																					
Power Factor Not Reached	–	–	–	–	–	–	–	–	O	O	O	O	O	O	–	–	–	–	O	O	O
Fuse Failure	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O
Over Temperature	–	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O
Over Pressure	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O
Unbalance	–	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O
Door Micro Switch	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O
LED Indication																					
Power Factor Not Reached	–	–	–	–	–	–	–	–	O	O	O	O	O	O	–	–	–	–	O	O	O
Stage On	–	–	–	–	–	–	–	–	O	O	O	O	O	O	–	–	–	–	O	O	O
Stage Off	–	–	–	–	–	–	–	–	O	O	O	O	O	O	–	–	–	–	O	O	O
Over Temperature	–	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O
Over Pressure	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O
Fuse Failure	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O
Unbalance	–	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O
Control Voltage Live	–	–	–	O	–	O	–	O	O	–	O	O	O	O	–	O	O	O	O	O	O
Power Voltage Live	–	–	–	O	–	O	–	O	O	–	O	O	O	O	–	O	O	O	O	O	O
Power Module																					
Capacitors	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S
Pressure Switches	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O
Contactor/Switches	–	–	–	–	–	–	–	–	S	S	S	S	S	S	–	–	–	–	S	S	S
HRC Fuses	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S
Fuse Failure Indication	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O
Connection Bus Bars	–	–	–	–	–	–	–	–	S	S	S	S	S	S	–	–	–	–	S	S	S
Unbalance CT	–	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O
Rapid Discharge VT	–	O	O	O	O	O	O	O	O	O	–	O	O	O	O	O	O	O	O	O	O
Cooling Fan/ Fan Forced Ventilation	–	–	O	O	O	O	O	O	–	–	–	O	O	O	S	S	S	S	S	S	S
Anti Condensation Heater	O	O	S	S	S	S	S	S	S	O	S	S	S	S	S	S	S	S	S	S	S
Earthing Stick	–	–	O	O	O	O	O	O	O	–	O	O	O	O	O	O	O	O	O	O	O
Ventilation	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S
Internal Lights	–	–	S	S	S	S	S	S	S	–	S	S	S	S	S	S	S	S	S	S	S

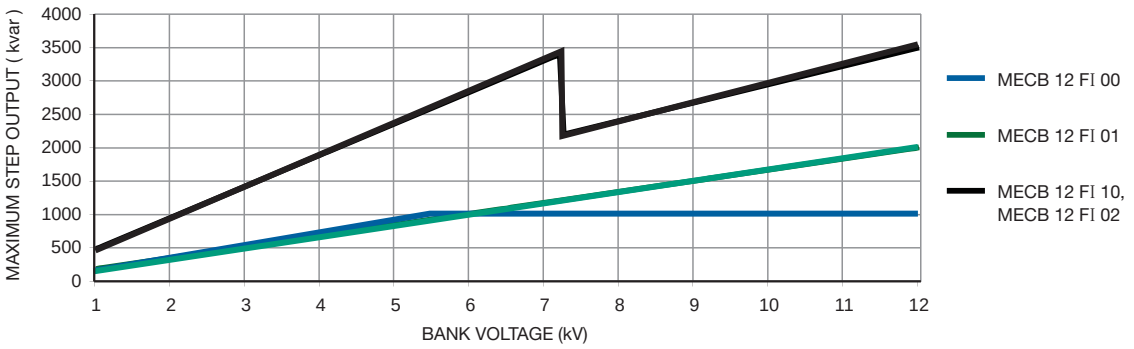
S Standard

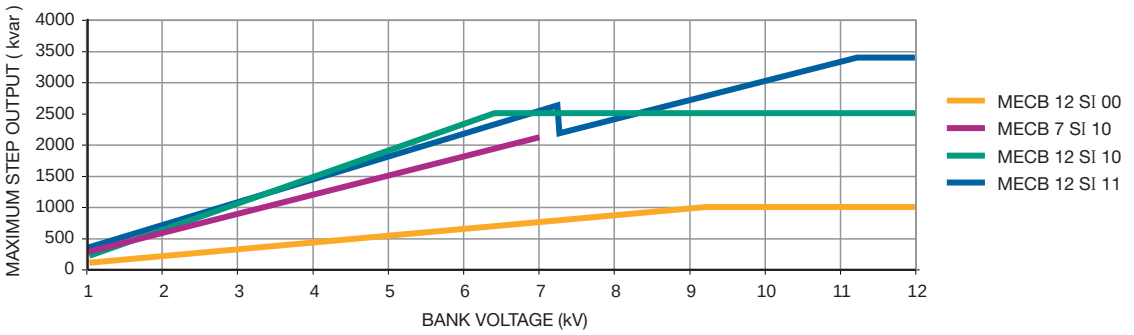
O Optional

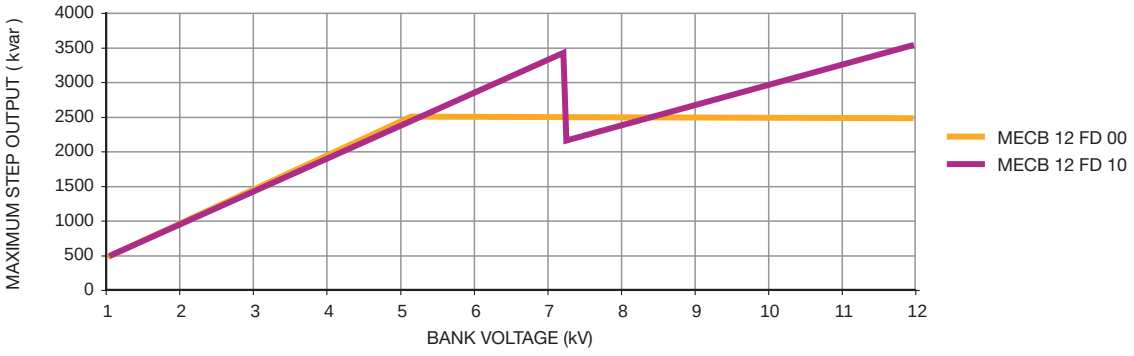
– Not Applicable/Not Available

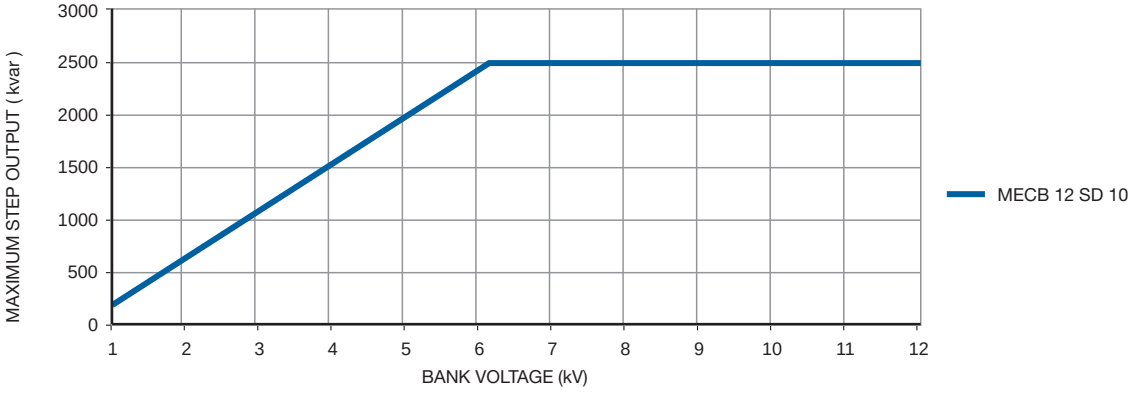
6.4 Maximum Power Module Capacity

6.4.1 Maximum Power Module Capacity ≤12 kV

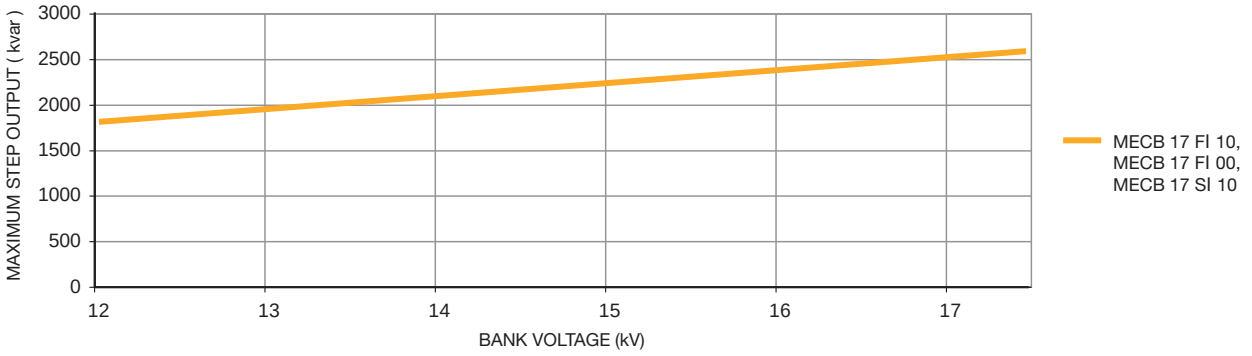


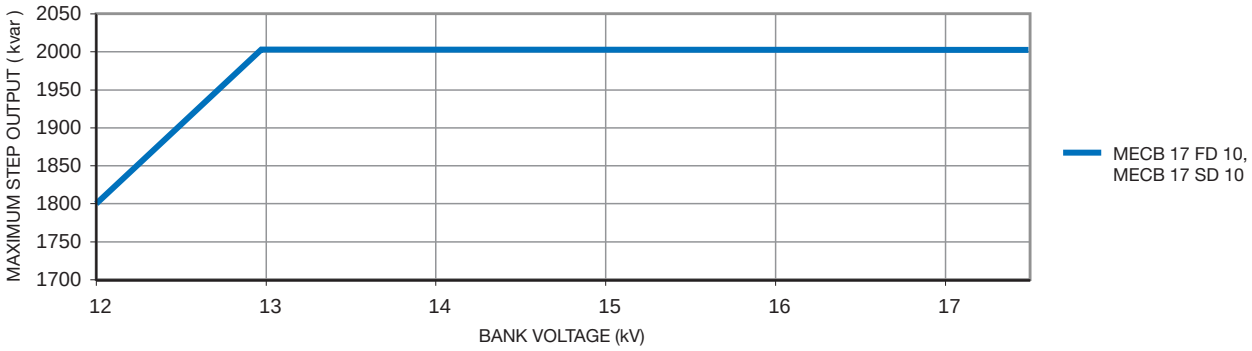




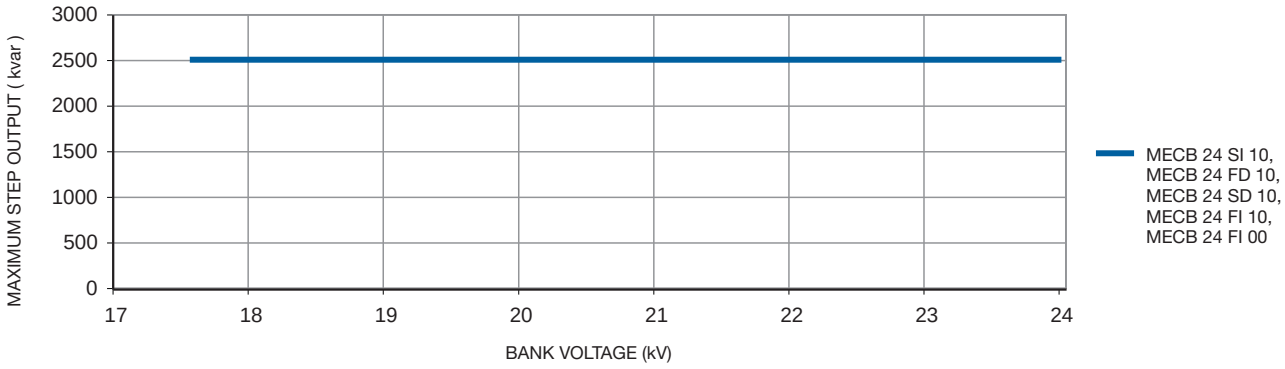


6.4.2 Maximum Power Module Capacity >12 kV – 17.5 kV





6.4.3 Maximum Power Module Capacity >17.5 kV – 24 kV



7. ABBACUS General Arrangement

The MECB is available in a range of assembly configurations making the ABBACUS suitable for a wide array of applications. The modular, expandable and compact design of the ABBACUS is able to satisfy current customer needs, whilst maintaining the flexibility to meet increased future demands if required.

The MECB 12 FI 00/12 FI 01/12 SI 00 models are designed for indoor use and are available in IP31 configurations. Connection to the customer network is facilitated by a cable entry box on the side of the cubicle, or from underneath the enclosure (if required).

The remaining models in the ABBACUS range are suitable for both indoor and outdoor applications and are available in configurations up to IP54. The design consist of an incomer module (excluding MECB 12 FD 00/12 FI 02/17 FI 00/24 FI 00) which facilitates connection to the customer network, assembled to one or up to four power modules (attached as needed) which generate the reactive power.

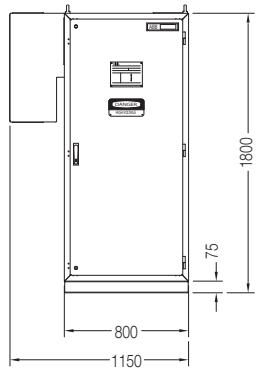
This section contains the available assembly configurations.

IP31 MILD STEEL INDOOR ENCLOSURE

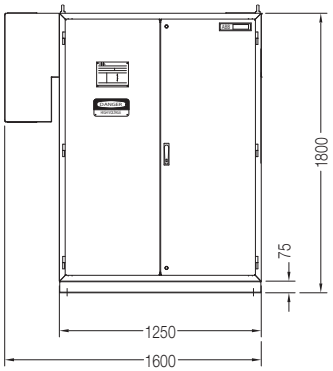
IP44 ALUMINIUM INDOOR/OUTDOOR ENCLOSURE

7.1 Mild Steel (Indoor Only) ABBACUS

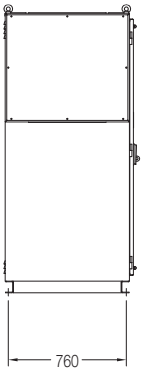
7.1.1 Assembly Configurations ≤12 kV



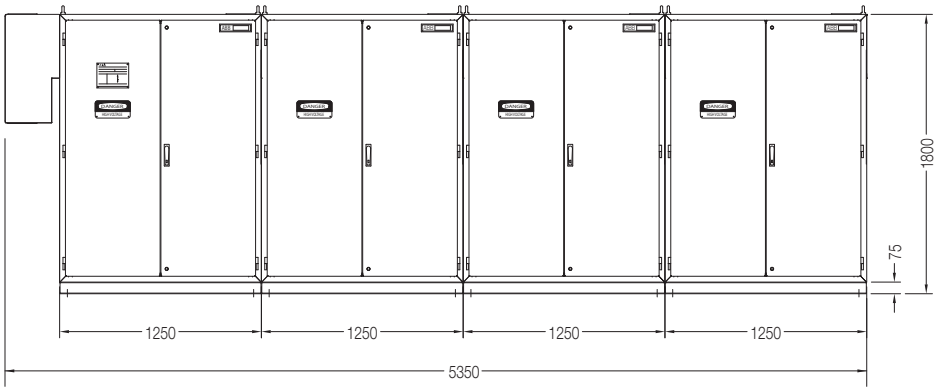
FRONT VIEW: MECB 12 FI 00



FRONT VIEW: MECB 12 FI 01

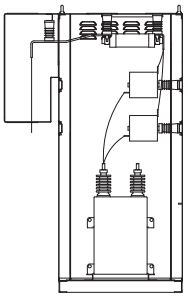


SIDE VIEW:
MECB 12 FI 00/01, MECB 12 SI 00

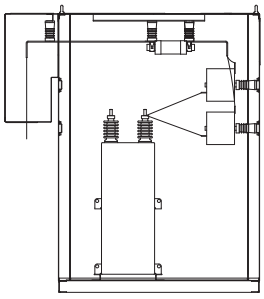


FRONT VIEW: MECB 12 SI 00
Cable entry box plus multiple power modules (up to 4 stages)

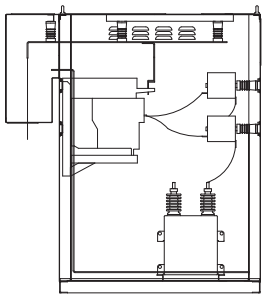
7.1.2 Power Modules ≤12 kV



MECB 12 FI 00



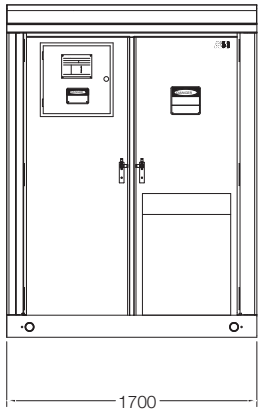
MECB 12 FI 01



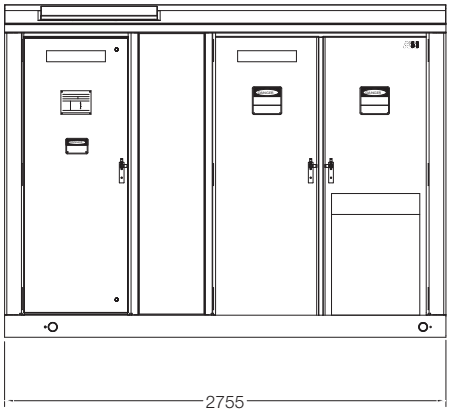
MECB 12 SI 00

7.2 Aluminium (Indoor/Outdoor) ABBACUS

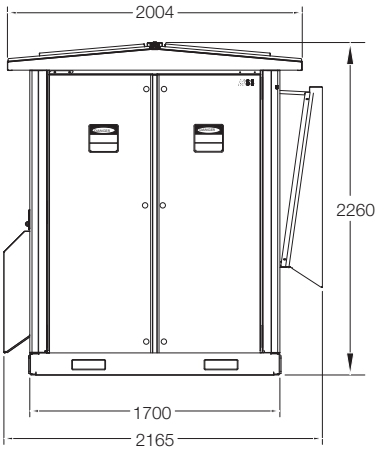
7.2.1 Assembly Configurations ≤12 kV



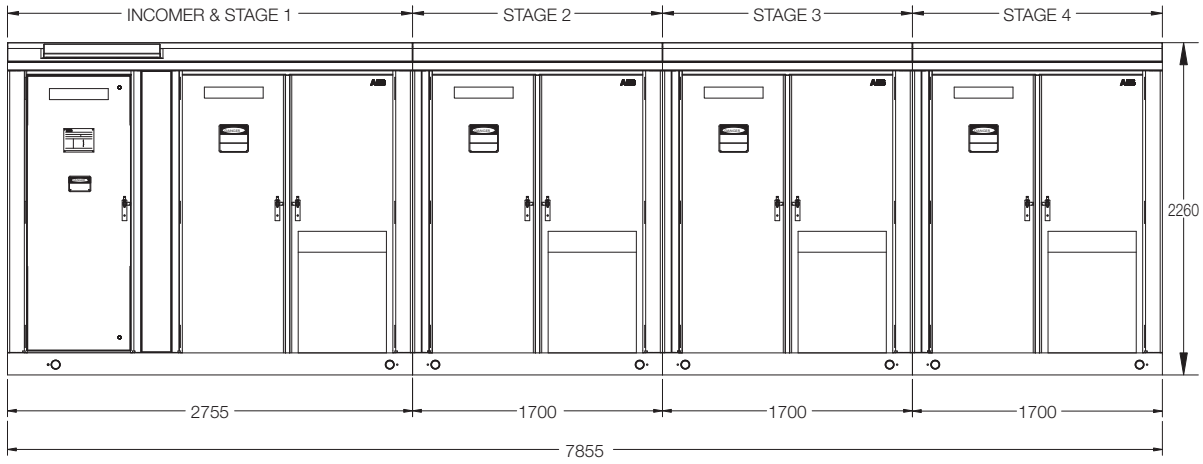
FRONT VIEW: MECB 12 FI 02 / MECB 12 FD 00



FRONT VIEW: MECB 12 FI 10 / MECB 12 FD 10

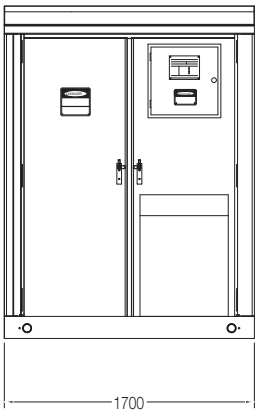


SIDE VIEW:
MECB 12 FI 02, MECB 12 FI 10, MECB 7 SI 10, MECB 12 SI 10, MECB 12 SI 11, MECB 12 FD 00, MECB 12 FD 10, MECB 12 SD 10,

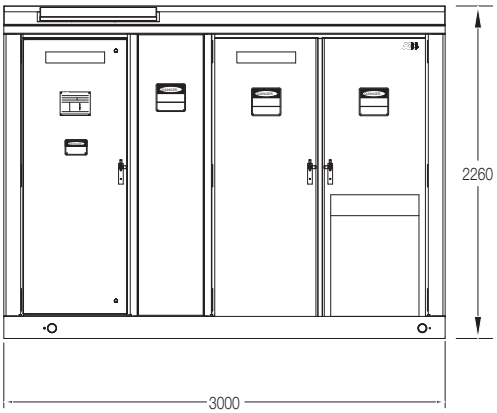


FRONT VIEW: MECB 7 SI 10, MECB 12 SD 10, MECB 12 SI 10, MECB 12 SI 11
Incomer plus multiple Power Modules (up to 4 stages)

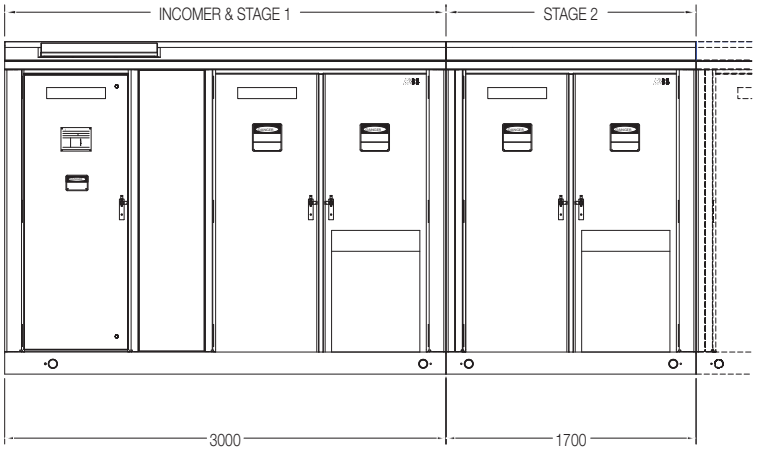
7.2.1.2 Assembly Configurations >12 kV – 17.5 kV



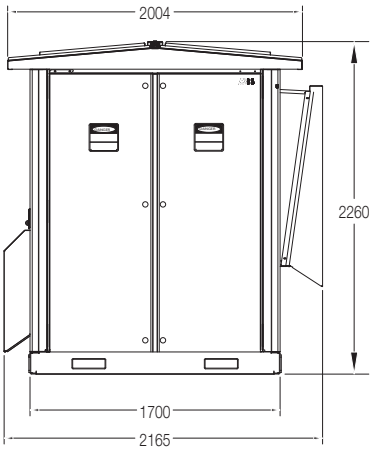
FRONT VIEW: MECB 17 FI 00



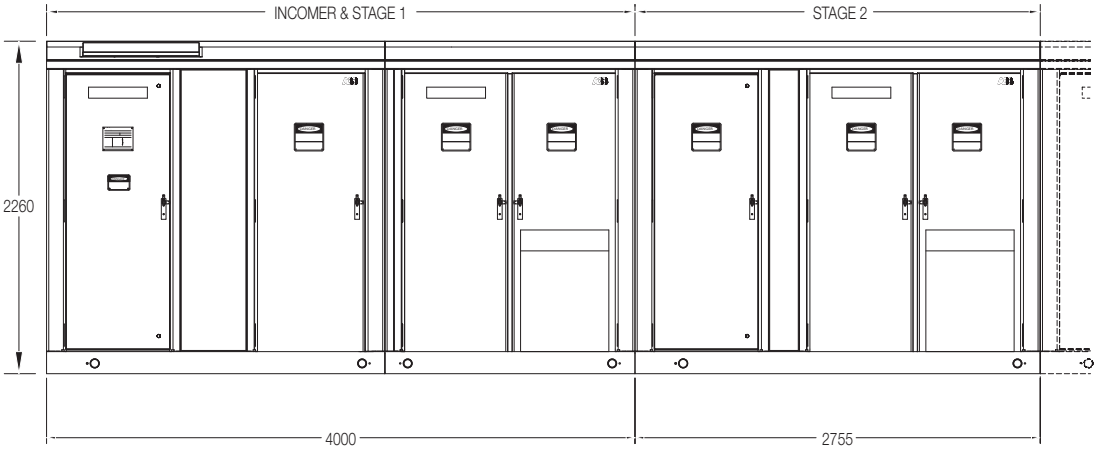
FRONT VIEW: MECB 17 FI 10, MECB 17 FD 10



FRONT VIEW: MECB 17 SI 10
Incomer plus multiple power modules (up to 4 stages)

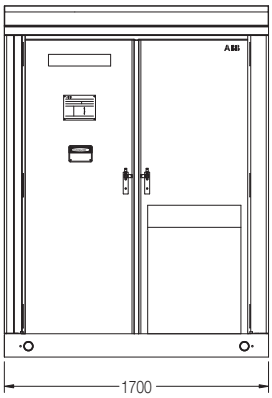


SIDE VIEW:
MECB 17 FI 10, MECB 17 FI 00,
MECB 17 SI 10, MECB 17 FD 10,
MECB 17 SD 10

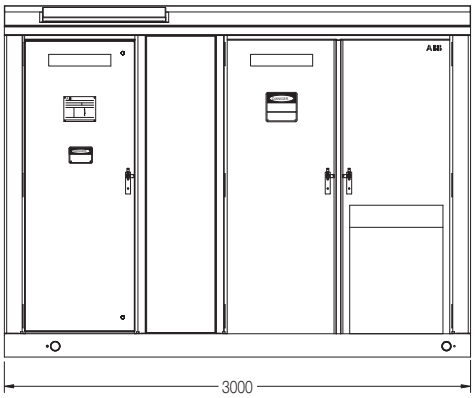


FRONT VIEW: MECB 17 SD 10
Incomer plus multiple power modules (up to 4 stages)

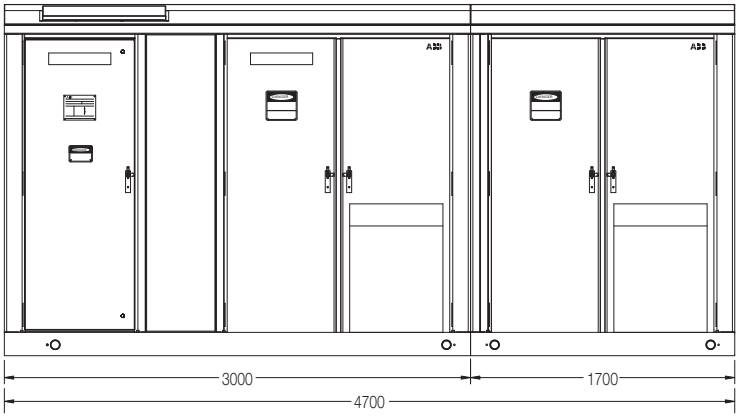
7.2.1.3 Assembly Configurations >17.5 kV – 24 kV



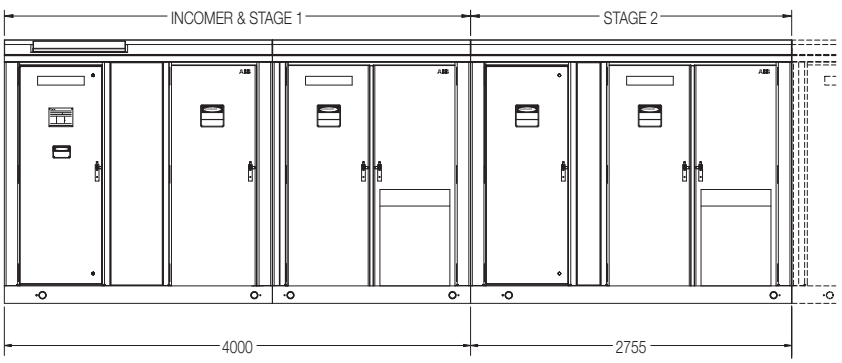
FRONT VIEW: MECB 24 FI 00



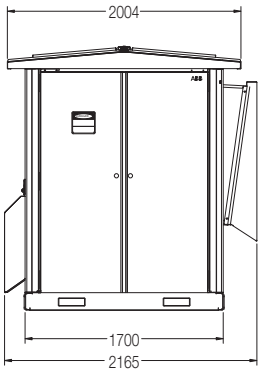
FRONT VIEW: MECB 24 FI 10



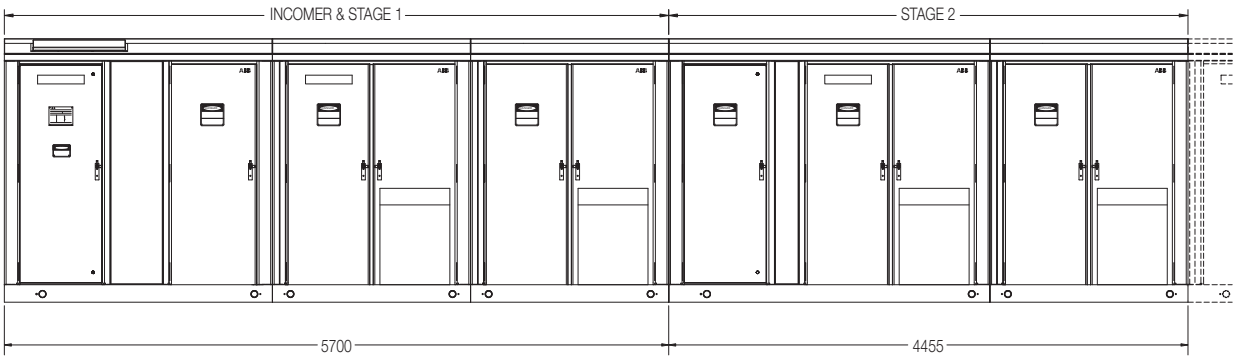
FRONT VIEW: MECB 24 FD 10



FRONT VIEW: MECB 24 SI 10
Incomer plus multiple Power Modules (up to 4 stages)



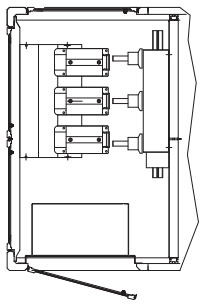
SIDE VIEW:
MECB 24 FI 10, MECB 24 SI 10
MECB 24 FD 10, MECB 24 SD 10



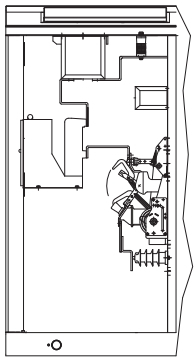
FRONT VIEW: MECB 24 SD 10
Incomer plus multiple Power Modules (up to 4 stages)

7.2.2 Incomer Modules

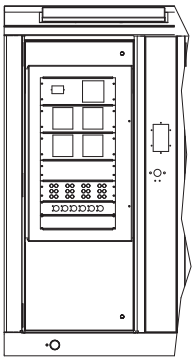
7.2.2.1 Incomer Module ≤12 kV



PLAN VIEW



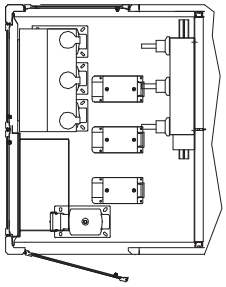
HIGH VOLTAGE SECTION
Front view with door removed (fully optioned)



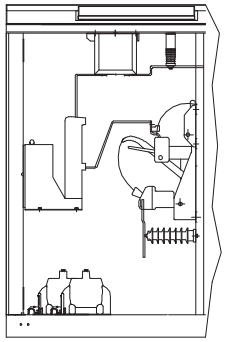
CONTROL CUBICLE

MECB 12 FI 10, MECB 7 SI 10, MECB 12 SI 10, MECB 12 SI 11, MECB 12 FD 10, MECB 12 SD 10

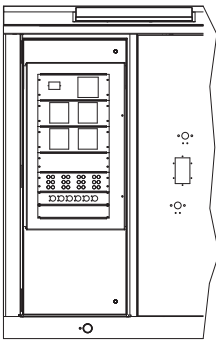
7.2.2.2 Incomer Module >12 kV – 24 kV



PLAN VIEW



HIGH VOLTAGE SECTION
Front view with door removed (fully optioned)

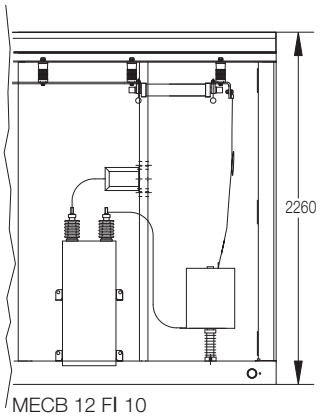


CONTROL CUBICLE

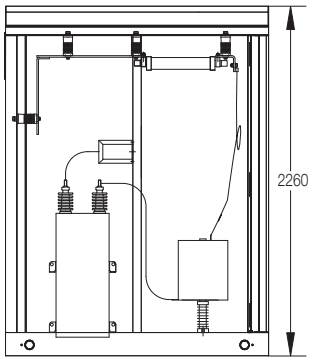
MECB 17 FI 10, MECB 24 FI 10, MECB 17 SI 10, MECB 24 SI 10, MECB 17 FD 10, MECB 24 FD 10,
MECB 17 SD 10, MECB 24 SD 10

7.2.3 Power Modules

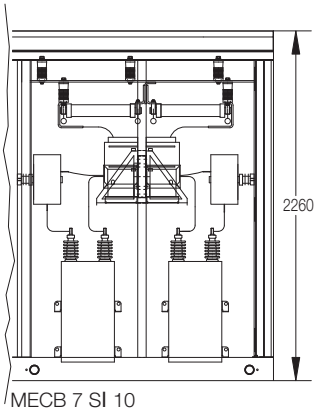
7.2.3.1 Power Modules ≤12 kV



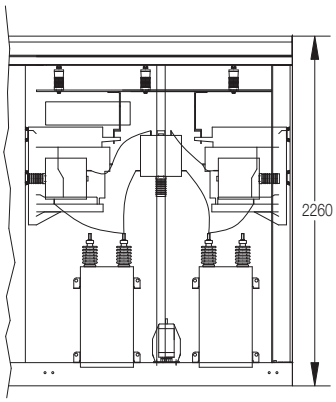
MECB 12 FI 10



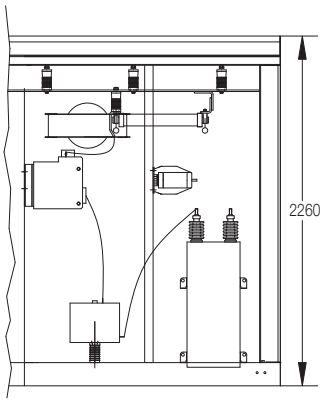
MECB 12 FI 02



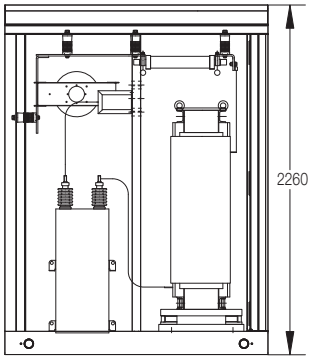
MECB 7 SI 10



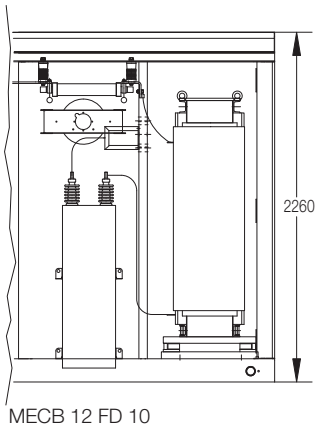
MECB 12 SI 10



MECB 12 SI 11



MECB 12 FD 00



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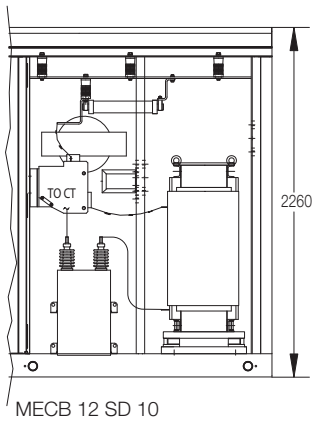
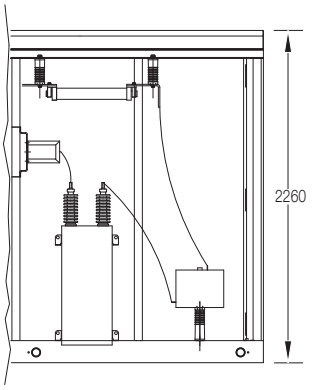


MECB 12 SD 10

7.2.3.2 Power Modules >12 kV – 17.5 kV



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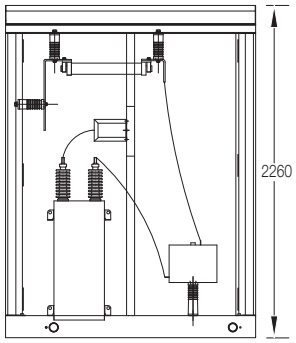

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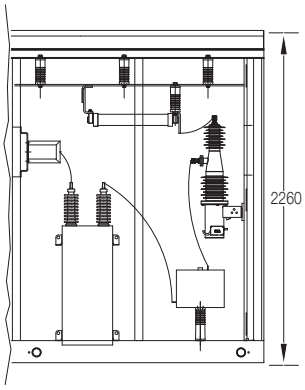

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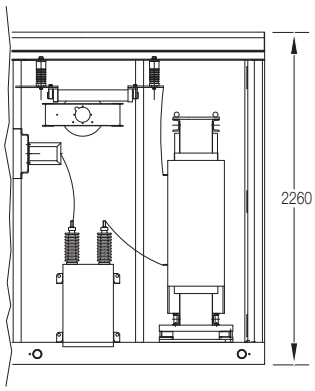

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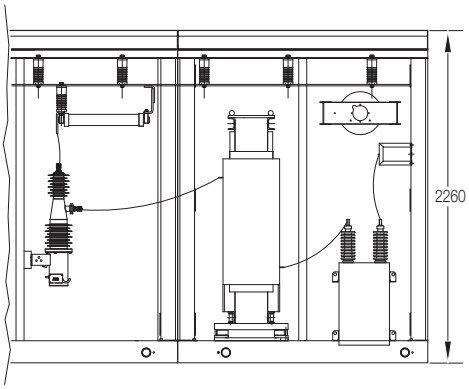
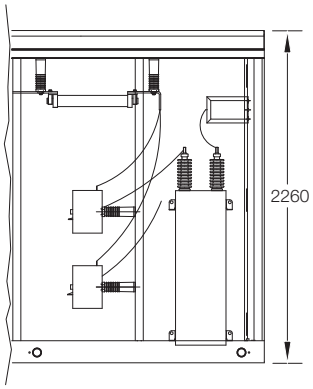


MECB 17 SD 10

7.2.3.3 Power Modules >17.5 kV – 24 kV



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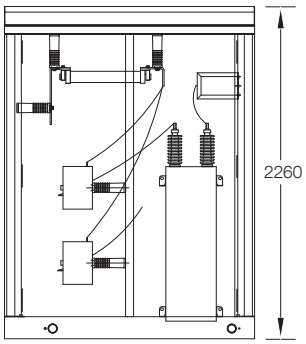

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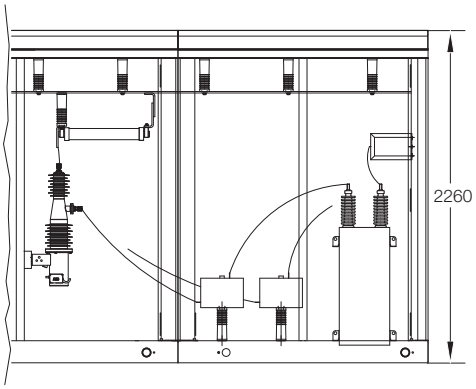

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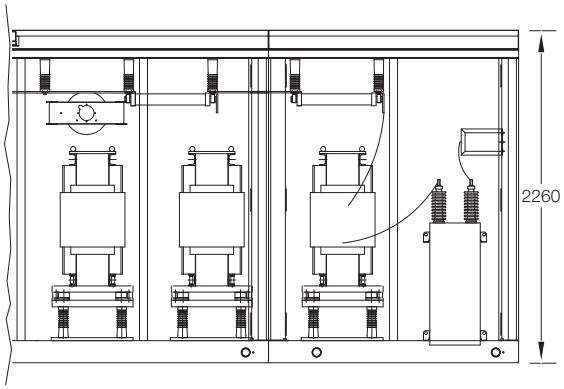

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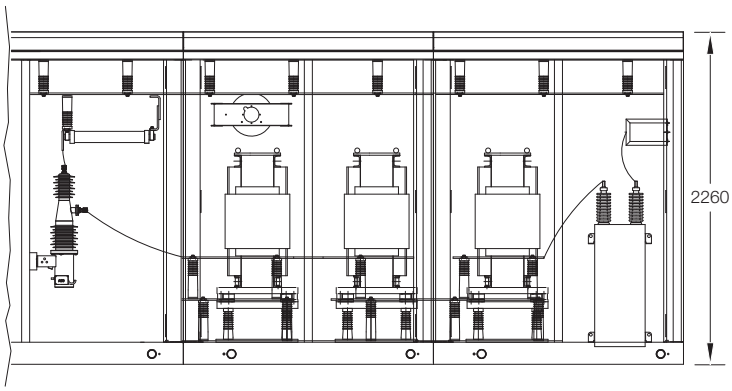

MECB 24 SD 10

8. Technical Specifications

The specification detailed below is for the standard ABBACUS.
Contact ABB for solutions outside this specification.

General

Voltage	1 – 24 kV
Control Voltage	230 – 240 V Standard
Maximum Output	Up to 13.2 MVar
Frequency	50 or 60 Hz
Location	Indoor or Outdoor
Ambient Temperature	–10/+45°C #1
Altitude	<1000 m above sea level
Humidity	Maximum 90% RH non condensing
Insulation Level	≤12 kV 28/75 kV BIL >12 kV – 17.5 kV 38 / 95 kV BIL >17.5 kV – 24 kV 50 / 125 kV BIL
Short Circuit Current	Up to 50 kA for 1 second #
Bank Configuration	Fixed, switched single or multistep
Standards	IEC or equivalent

Capacitors

Type	Single, three or split-phase
Fusing	Internal or unfused
Discharge Resistor	Built-in
Losses	<0.2 W / kVar including resistors
Dielectric	Polypropylene film
Impregnant	Faradol 810 non PCB
Container	Stainless steel
Bushings	Grey porcelain one, two or three

Inrush Reactors

Type	Single phase, air core
Inductance	Specific to application
Continuous current	1.43 x capacitor current
Temperature class	Max T55/F

Detuning (Filter) Reactors

Type	Single or three phase, iron core
Inductance	Specific to application
Continuous current	Specific to application
Harmonic loading	Specific to application
Limit of linearity (95%)	≥1.7 x Nominal Current
Temperature class	Max. T55/F

Contactors and Switches

ABB Model	**VSC Electrically Latched**
Voltage	7.2 kV
Type	Vacuum
Phase	Three
Continuous current rating	230 A capacitive
Mechanical endurance	100,000+ CO
Auxiliary contacts	Available
Mechanism	Magnetic actuator

ABB Model	**V-contact Electrically Latched**
Voltage	7.2, 12 kV
Type	Vacuum
Phase	Three
Continuous current rating	230 A capacitive
Mechanical endurance	100,000+ CO
Auxiliary contacts	Available
Mechanism	Magnetic actuator

ABB Model	**PS15, PS25 Electrically Latched**
Voltage	15, 25 kV
Type	Vacuum
Phase	Single
Continuous current rating	200 A capacitive
Mechanical endurance	25,000+ CO
Auxiliary contacts	Available
Mechanism	Magnetic actuator

Circuit Breaker

ABB Model	**VD4**
Type	Vacuum
Phase	Three
Current rating	630 A
Short time current	25 kA for 1 sec #
Auxiliary contacts	Available
Mechanism	Motor
Interlocking	Optional

Isolator

ABB Model	**NAL**
Type	Air insulated
Phase	Three
Current rating	630 A
Short time current	25 kA for 1 sec #
Auxiliary contacts	Available
Mechanism	Snap action spring (hand operated)
Interlocking	Optional

Earth Switch

ABB Model	**E, EB**
Type	Air insulated
Phase	Three
Short time current	25 kA for 1 sec #
Auxiliary contacts	Available
Mechanism	Snap action spring (hand operated)
Mechanical interlock with Isolator	Where fitted
Interlocking	Optional

Fuses

ABB Model	**CEF, CMF**
Type	HRC
Rated current	Up to 315 A#
Short time Current	50 kA (max)
Striker pin	Fitted
Fuse clips	Retaining type
Mounting	Horizontal

Surge Arresters

ABB Model	**MWD**
Nom. Discharge current	10 kApk (8/20 s)
Class	2
Short circuit rating	20 kA for 0.2 sec
Energy capability	5.5 kJ / kV of Uc
Material	Silicon rubber

Cooling Fan

Type	Centrifugal
Volume	2960 m^3/hr
Noise level	67dBA
Power	290 W

Capacitor Unit Pressure Switch

Pressure setting	1 bar
Contact rating	10 A, 240 VAC
Mechanical life	106 operations at 50 bar
Contact Type	Changeover

Anti-condensation Heater

Heat output	800 W

Busbars

Type	Hard drawn copper
Surface finish	Tinned
Size	40 mm x 10 mm 50 mm x 10 mm 100 mm x 10mm

Voltage Transformer (rapid discharge)

ABB Model	**TDC4**
Type	Epoxy resin cast
Primary	Specific to application
Secondary	Not applicable
Discharge capability	4 Mvar at rated voltage down to 50 V in 20 sec

Voltage Transformer (protection)

SADTEM	**Y12P**
Type	Epoxy resin cast
Primary	Specific to application
Secondary	Specific to application
Class	3P
Burden	Up to 30 VA

Current Transformer (unbalance)

ABB Model	**TPU 40.11**
Type	Epoxy resin cast
Primary	Specific to application
Secondary	1 A
Class	1.0 M
Burden	15 VA
Short Time Current	2 kA for 1 sec

Current Transformer (protection)

ABB Model	**TPU 40.11**
Type	Epoxy resin cast
Primary	Specific to application
Secondary	5 A
Class	5P20
Short Time Current	25 kA for 1 sec

Voltage Transformer (control)

ABB Model	**TDC4**
Type	Epoxy resin cast
Primary	Specific to application
Secondary	Specific to application
Class	1.0 M
Burden	Up to 150 VA

Live Line indication

Voltage Rating	3 kV to 75 kV
Indication Type	LED
Connection method	Busbar clamp
Viewing	Enclosure window

Door Micro Switches

Contact Rating	5 A, 240 VAC
Mechanical endurance	10,000,000 CO
Contact type	Changeover

Enclosure

Material	'AA' Grade Corrosion Resistant Aluminium or Zinc-coated steel*
Base frame	Hot dipped galvanized steel
Protection	IP31 indoor, IP44/IP54 outdoor
Paint system	Powdercoat RAL 7035
Door locking	Front: Three point lockable handle. Side and Rear: Blind ¼ turn locks
Safety Interlocking	Optional
Installation	Base fixing
Handling	Fork and crane lifting via base forklift or lifting brackets Lifting eye bolts*
Cable entry	Bottom or optional side wall

Power Factor Controller

ABB Model	**RVC, RVT**
Measuring System	Microprocessor-based system for single or three phase system Insensitive to harmonics
Control Voltage	110 VAC to 440 VAC
Burden	15 VA
Current input	5 A
Alarm Contact	Normally closed 1.5 A, 250 VAC
Power Factor	Setting 0.7 inductive to 0.7 capacitive
Communication	MODBUS (RVT only)

Over Current/Earth-Fault Protection Relay

ABB Model	**SPAJ140C**
Measuring System	Microprocessor-based
Control Voltage	80 VAC to 265 VAC
Burden	15 VA
Current input	1 or 5 A
Alarm/Trip signal	Volt-free contacts

Unbalance Protection Relay

ABB Model	**SPAJ141C**
Measuring System	Microprocessor-based
Control Voltage	80 VAC to 265 VAC
Burden	15 VA
Current input	0.2 or 1 A
Alarm/Trip signal	Volt-free contacts

Unbalance/Overload Protection Relay

ABB Model	**SPAJ160C**
Measuring System	Microprocessor-based
Control Voltage	80 VAC to 265 VAC
Burden	15 VA
Current input	1 or 5A
Alarm/Trip signal	Volt-free contacts

Under/Over-Voltage Protection Relay

ABB Model	**REU610**
Measuring System	Microprocessor-based
Control Voltage	80 VAC to 265 VAC
Burden	15 VA
Current input	1 or 5 A
Alarm/Trip signal	Volt-free contacts

Safety Interlocking

Type	Mechanical or solenoid
Scheme	Specific to application
Mounting	Single and double door Keys Supplied
Options	Key exchange box Time delay units

Fuse Failure Indication

Contact Rating	6 A, 250 VAC
Contact type	Changeover

Earthing Sticks

Stick	Fibreglass rod, 1.8 m
Application Method	Removable bayonet
Earthing	Braid to main earth bar
Fault Level	13.1 kA for 0.5 sec
No of Phase Cables	3
Cable Lengths	3 m

Please refer to individual product brochures for detailed information on each component or contact ABB.

* Applies only to MECB 12 FI 00, MECB 12 FI 01 and MECB 12 SI 00
# Higher ratings available
#1 Lower temperature ratings available

Contact us

Please contact your local sales representative for further information

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