



Eaton – Safe, Reliable, Efficient IEC MV Switchgear

xGear

Safe, Reliable, Efficient
IEC MV Switchgear

EATON

Powering Business Worldwide

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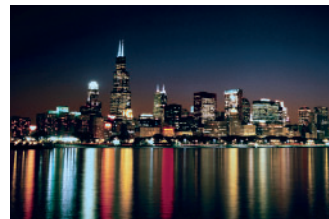
Technology leader Eaton consolidates its position in the field of Medium Voltage Switchgear: thanks to design-verified switchgear assemblies that are able to “grow” and keep up with increasing future requirements.

Eaton Corporation, headquartered in Cleveland, Ohio (USA), pursues a diversified business strategy and is considered to be the unrivalled technology leader in many business fields. Its Electrical Sector alone is the worldwide leader for products and services related to power distribution, safe power supply and industrial automation.

A successful globally provider

Eaton is active as a specialist in Electrical Distribution and Control Systems and Applications. A significant share of its success is based on the explicit principle of being a fullline provider. No matter what the area of application may be, you will get everything from power switchgear to individual components from a single source. And Eaton, being the technology leader, always aims to offer today what’s going to be standard tomorrow.

Eaton – 5 areas of success



As a worldwide leading provider of products and services in the fields of electrical control-gear, power distribution, uninterrupted power supply (UPS) and industrial automation.



As a worldwide market leader in terms of design, manufacture and sale of entire series of drive systems and components for medium and heavy-duty commercial vehicles.



As a worldwide leading supplier for civil air transport and military aviation as well as for the aerospace industry, with a comprehensive technology portfolio including hydraulic systems, fuel supply systems, motion-control and engine systems.



As an important supplier of critical components allowing to reduce emissions and fuel consumption and to improve the stability and performance of cars, light trucks and commercial vehicles.



As a worldwide leading manufacturer of reliable, highly efficient hydraulic systems and components for mobile and industrial applications for many different business sectors from mining to the entertainment business.



Powering Electrical Systems Worldwide

Eaton Corporation is a worldwide leader in the design, manufacture, and sale of safe, reliable and high-performance medium voltage power distribution equipment in accordance with IEC, GB and ANSI standards.



Complete Global Medium Voltage Switchgear Solutions

Eaton, a premier leader in designing and manufacturing power distribution and protection equipment in the electrical industry, offers a comprehensive range of medium voltage (MV) solutions to meet the needs of virtually every application. From products that feature cutting-edge design that allow for easy access, maintenance and space savings, to arc-resistant products that enhance safety, Eaton’s medium voltage solutions provide a variety of products for every need. Additionally, Eaton’s global service network provides maximum customer support in all regions of the world.

As one of the few completely vertically integrated and diversified industrial manufacturers in the world, Eaton designs not only MV assemblies, but also the key components that comprise the MV solutions – from steel housing and circuit breaker compartments to vacuum interrupters, circuit breakers, bus systems and fuses.

Eaton’s MV heritage, strengthened by acquisitions such as Westinghouse DCBU, Cutler Hammer and Holec, has resulted in breakthrough MV technologies and numerous international patents over the years.

Part of Eaton’s complete electrical PowerChain Solutions – which help businesses minimize risks while realizing greater reliability, cost efficiencies, capital utilization and safety – Eaton’s medium voltage equipment meets and is third party certified to all applicable standards and certifications such as IEC, NEMA / ANSI, GB, DL, UL, IEEE, KEMA and CSA.

When it comes to medium voltage solutions, you can trust the one name with a long history of proven performance: Eaton.



Basic design

xGear is modular in construction, ensuring that any panel combination and rating can be applied on a system.

In addition, there is no limit to the number of panels that can be used in an installation, as several sections can easily be connected together. Because the panels can be quickly assembled and connected, flexible commissioning of the switchgear is an added benefit.

1 Arc chamber

The integral arc-chamber evacuates the gasses associated with an internal arc. Optional standard parts are available to extend the arc chamber; flanges and grilles are available to exhaust the gasses outside the switchgear room.

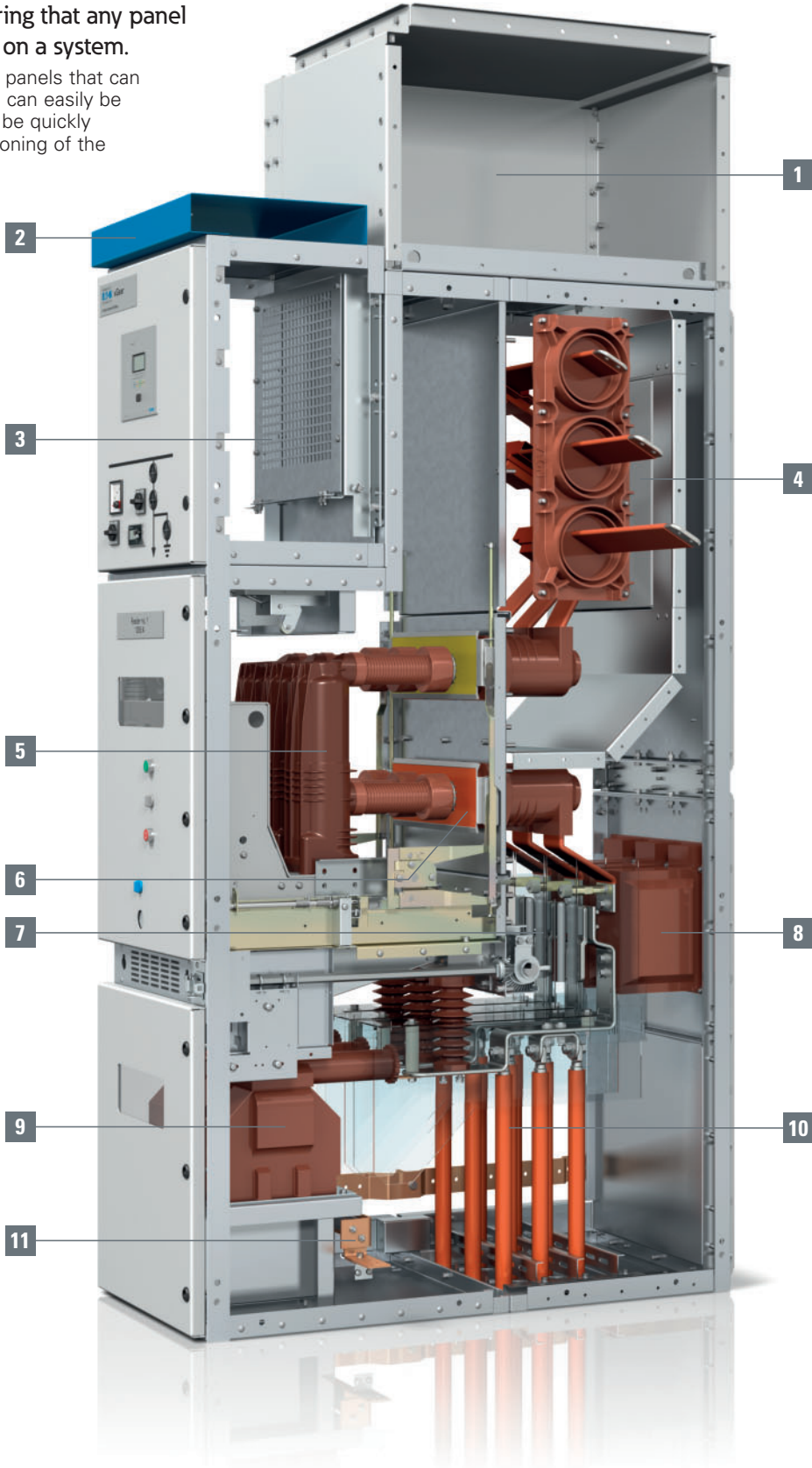
2 Low voltage wire-way for inter panel wiring

A fully segregated metal wire-way is mounted at the top of each switchgear panel that connects together to form a continuous low voltage wire-way that runs along the entire length of the switchgear.

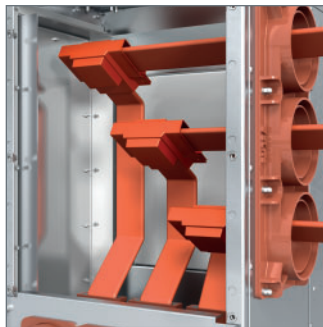
3 Low voltage compartment



The compartment is segregated with earthed metal partitions and has ample space for any protection and control devices specified by the user.



4 Busbar compartment



Busbars are totally enclosed in their own earthed metal compartment which vents into the arc chamber. Fully insulated along their entire length, the busbars are type tested for ratings up to 3150A, 31.5kA for 3 seconds. Epoxy mouldings segregate switchgear sections.

5 Vacuum circuit breaker compartment



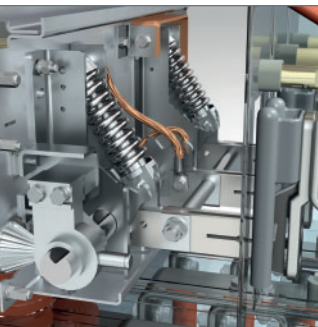
Fully segregated by earthed metal partitions, with its own pressure relief channel into the arc chamber, the compartment provides all the safety interlocking mechanisms required for safe and reliable operation of the vacuum circuit breaker. Manual operation buttons allow for full operation of the vacuum circuit breaker from the front of the switchgear with the door fully closed. The circuit breaker is mechanically interlocked with the compartment door so that the door cannot be opened until the circuit breaker is switched Off and racked out into the Test position.

6 Automatic shutters



Individually operated automatic earthed metal shutters for both the Line (busbar) and Load (cable) connections can be padlocked in the closed position. When the breaker is in Test or Disconnect positions the shutters automatically close to prevent accidental contact with any live parts.

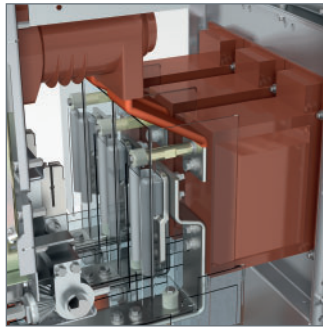
7 Circuit earth switch



The earth switch is operated from the front of the switchgear, with mechanical indicators to show the switch position. A window allows direct viewing of the earth switch position. The earth switch is mechanically interlocked with the circuit breaker or contactor truck such that it can only be closed when truck is in the Test/Disconnect position. The circuit earth switch can be mechanically interlocked

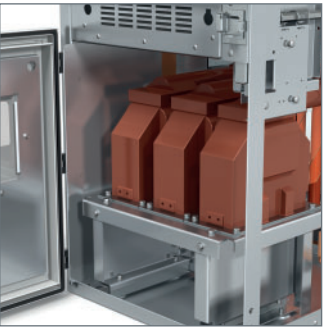


8 Current transformers



Cast resin CTs are provided as standard in a wide range of ratings, with an option to use low voltage tape-wound CTs in the same location.

9 Voltage transformers



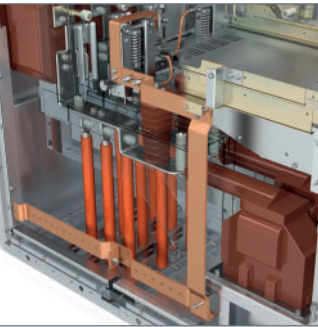
The voltage transformers are available in 3 configurations: Fixed, Withdrawable with shutters, and Withdrawable without shutters. All options are fitted with withdrawable primary fuses. The compartment door can be interlocked with the earth switch to ensure that the cables are safely earthed before the door is opened. The withdrawable option with shutters can be disconnected from the supply with the compartment door closed and with cables still live. The door can then be opened to remove the transformers safely.

10 Cable terminations

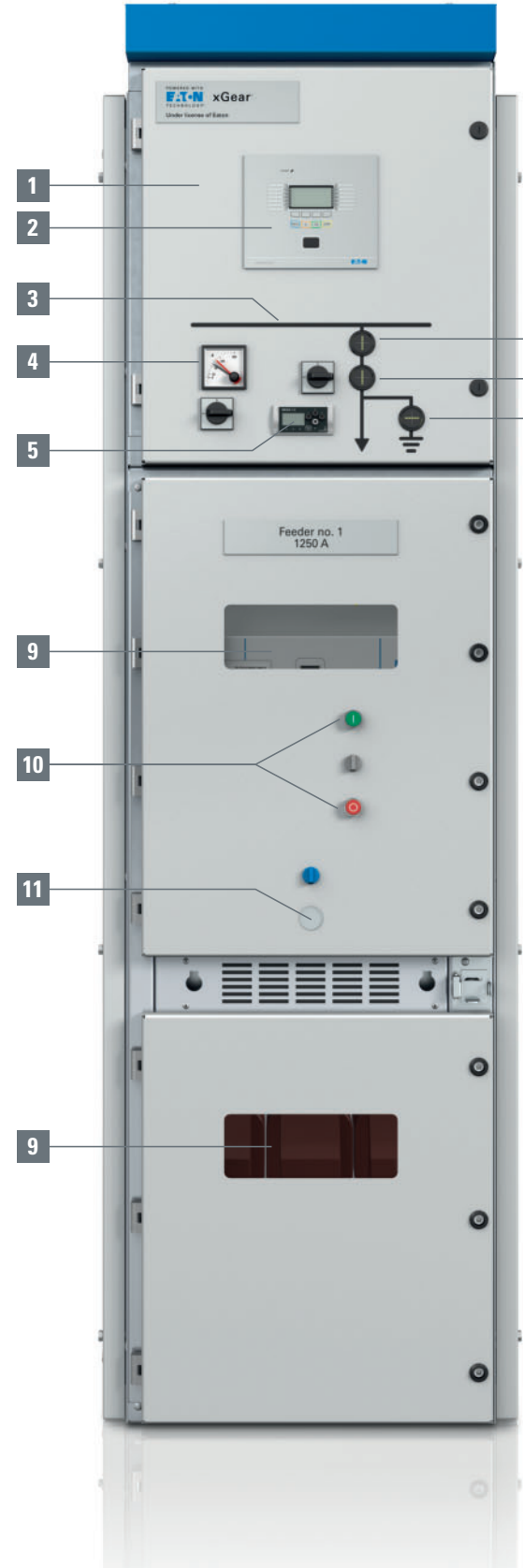


Ample cable termination provision is provided up to 6 single core cables per phase to enter the bottom of the switchgear and are terminated with compression lugs onto copper tails provided in the bottom of each panel.

11 Earth bar



An earth bar system is provided making connections to the station earth easy and effective. The earth bar system has been fault tested and runs vertically and horizontally within each panel section and is connected to the earth switch, when provided.



1 Low voltage control and protection compartment

Clear to view panel with all controls and indications clearly visible and easy to operate.

2 Control and Protection

Eaton has a range of preferred relay options that can be fitted as standard. However, customer specific protection relays from any manufacturer can be fitted to the compartment door.

3 Mimic diagram

Easy to understand mimic diagram of each circuit.

4 Metering with phase selector switch

Option for an ammeter and phase selector switch.
Option for voltmeter and phase selector switch.

5 Voltage detection system

Each circuit breaker panel can be equipped with an optional standard three phase voltage detection system for voltage detection to IEC 61243-5. The VDS is driven from a capacitive divider fitted within the insulators connected to the cable connection and shows the operator if the connected cable is live.

6 Circuit breaker position indicator

Breaker position indication shows the breaker in the Connected/Service or Disconnected/Test position.

7 Electrical operation with circuit breaker status indicator

Breaker Open/Closed status indicator.
Breaker Open/Closed command switch.

Optional LED indication of spring charge mechanism "Charged" status

8 Earth switch indicator

Optional LED indication of earth switch Open/Closed status.

9 Viewing windows

The circuit breaker compartment door viewing window provides visual indication of the position of the circuit breaker indicating:

- The status of the breaker
- The status of the spring-charged mechanism

The cable compartment door viewing window allows visual indication of:

- The status of the earth switch
- Inspection of the cable connections

10 Manual circuit breaker operation

Circuit breaker Open and Close buttons

11 Circuit breaker racking mechanism

Circuit breaker racking In/Out mechanism

Vacuum circuit breaker

Type W-Vaci

The vacuum circuit breaker uses a simple and reliable, true two step spring charged mechanism for operation of the vacuum interrupters. The construction of the mechanical linkage between the actuator and the drive rod of each of the three vacuum interrupters is simple and effective.

Features

- Environmentally friendly vacuum interrupters totally encapsulated within pole units constructed of solid epoxy resin
- Mechanically and electrically trip-free stored energy mechanism design
- Integrated mechanical lever for manual charging operation with pushbutton control
- Spring charged indicator with contacts for remote indication of spring status
- Mechanical status indicator for Open/Closed
- Auxiliary contacts for Open/Closed position
- Position indicator for Connected/Test position within the compartment
- Auxiliary contacts for remote position indication
- Mechanically interlocked with the compartment door
- Mechanical interlock to ensure the breaker is in the open position before it can be racked-in or racked-out

Contactors

Type SL400

For motor starters, transformers and capacitor switching, the xGear system is available with vacuum contactor and fuse combination trucks. Surge arresters can be mounted at the cable terminals. For motor control applications up to 7.2 kV, xGear incorporates the Eaton range of SL contactors. For motor starters at 12 kV please contact Eaton.

Features

- Environmentally friendly vacuum interrupters
- Ratings up to 400 amps at 6.6 kV
- Capacitor switching up to 295 amps at 6.6 kV
- Maximum interruption current of 8.5 kA
- Fuse protected up to 50 kA
- Electronic coil control for optimum control of the coil voltage and reduced watts loss means more efficient use of power and lower heat generation
- Electronic coil control allows for field selectable control voltages and drop out times
- Up to 6 auxiliary contacts in any combination of Normally Open and Normally Closed configurations
- Mechanical latch option is available with electrical unlatch signal.

Proven experience and knowledge gained by Eaton over many years in the areas of cast-resin technology, vacuum technology, arc interruption and electrical field control have been integrated in the design and development of xGear - ensuring that the switchgear is safe and has high operational reliability throughout its lifetime.

Internal Arc Classification (IAC) of AFLR

While the integrity of the equipment to provide continuity of supply was a major design consideration throughout its development, the safety of the operator has also been one of the most important criteria, with a number of reassuring features built in. Eaton has always emphasised the need to design and create safe switchgear for operators at all times.

One of the biggest potential threats to operators is an internal arc in the switchgear. The metal-clad design and the robust construction has enabled xGear to successfully pass internal arcing test in accordance with IEC 62271-200 in all three primary compartments and provides an IAC rating of up to 31.5 kA for 1 second.

Loss of service continuity classification

IEC62271-200 describes the extent to which the switchgear and control gear are allowed to remain operational in case access to a main compartment is necessary.

xGear has the highest attainable level of Loss of Service Continuity of LSC2B.

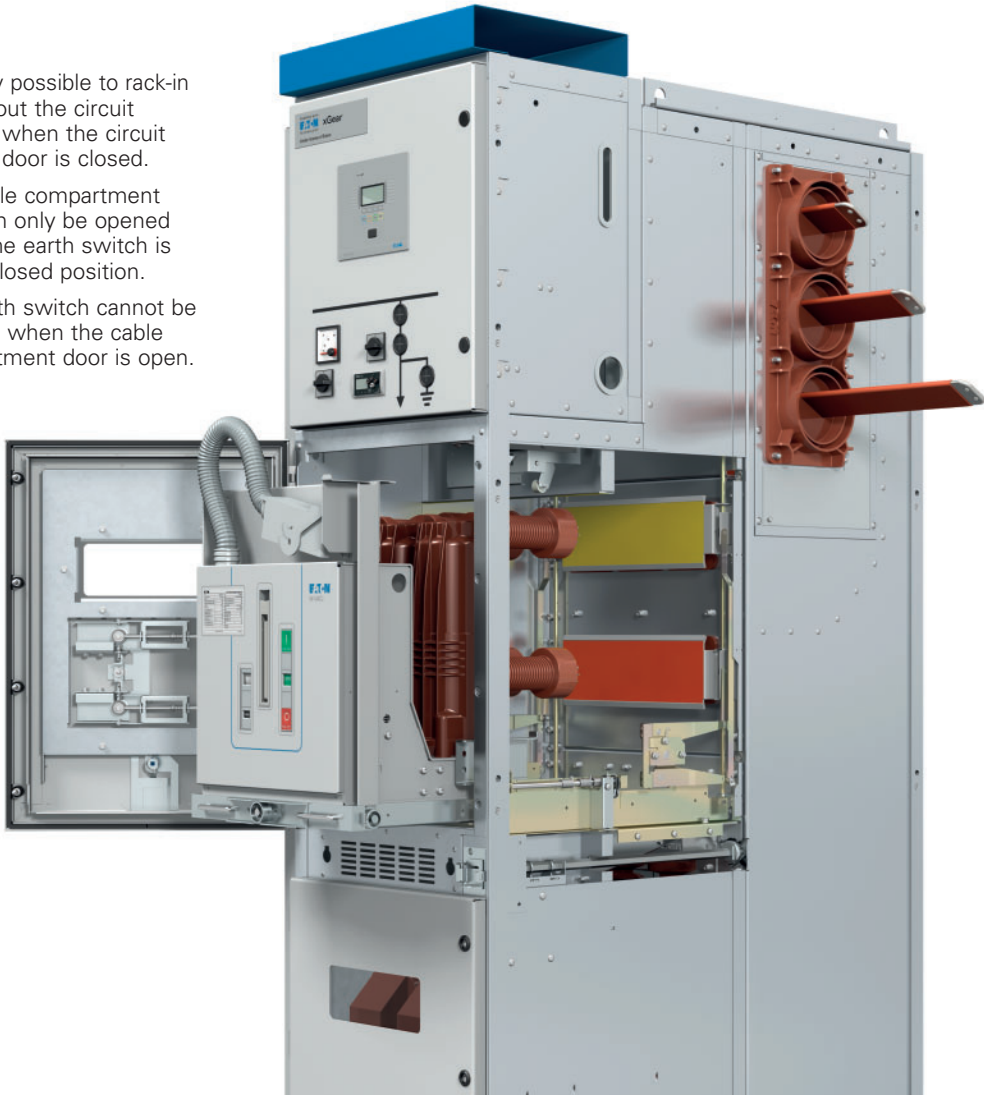
Partition classification

In addition to the IAC and the LSC classifications, IEC62271-200 defines the type of partitions required between each panel and between each functional unit within the panel.

xGear employs only earthed metal partitions and therefore has the highest level of partition classification of PM.

For personnel safety xGear is designed with a number of comprehensive mechanical interlocks to prevent unsafe operation.

- It is not possible to rack-in or rack-out a circuit breaker unless it is in the Off or Open position.
- It is not possible to close a circuit breaker unless the circuit breaker is in the Connected or Test position.
- The secondary socket can only be disconnected with the circuit breaker in the test position.
- Closing the circuit breaker is only possible with the secondary contacts connected.
- It is not possible to close the earth switch when the circuit breaker is in the Connected position.
- The door of the vacuum circuit breaker compartment can only be opened when the circuit breaker is in the Disconnected / Test position.



Sustainability

Environmentally friendly

xGear is designed to be environmentally friendly throughout the life-cycle: from production, during service and at the end-of-life.

One of Eaton's key strategic initiatives is to provide environmentally friendly products. This requires examination of the total life-cycle, from design to decommissioning.

The product life-cycle can be divided into five main blocks. These blocks are

- The design
- Materials used
- The assembly
- The operational phase
- The decommissioning

Eaton's production plants act entirely in accordance with the rules and procedures of the ISO 14001 environmental certificate during development and production processes.



Flexibility in design

Every application of this type of system is unique, xGear offers a wide range of different panel types and field versions.

If, in due course, additional capacity in the form of more panels is required, the system can easily be extended to the right or left with only minimal disruption to the supply for final connection of the busbars.

Customers often have their own requirements with respect to the use of protection and control components within switchgear, so the need for specific components was taken into account during product development and resulted in a basic primary design that enables customers to integrate secondary protection and control components according to their own specification requirements.

Range of voltage transformers

All xGear panels can be fitted with cast-resin insulated voltage transformers, of the requested transformer ratio and class, for voltage measurement on the cable side, or on the busbar side.

The standard configuration is for a fixed voltage transformer with withdrawable fuses - although an option for truck



mounted withdrawable voltage transformers is also available.

Range of current transformers

In order to provide protection and metering, the cast-resin insulated current transformers are housed in the fixed section near the feeder cable terminals. All common transformer ratios, outputs, rated currents and classes are possible.

Smart Grids and substation automation

Equipment for remote communication between panels or automation systems can also be installed in the low voltage compartment, making the system the perfect solution for current and future Smart Grid applications.

Protection and control equipment

The protection and control equipment is located in a completely separate low voltage compartment with its own access door. There is space on the door for a mimic diagram and for mounting equipment such as protection relays, voltage detection systems, meters, etc.

In case additional space is required, the low voltage compartment can be extended.



Fully type-tested to latest IEC standards

The switchgear is type tested to the latest IEC 62271-200 standard and has third party certification to prove internal arc containment classification of AFLR.

xGear complies with the following international standards

IEC 62271-1	Common specifications
IEC 62271-100	Circuit breakers (E2, M2, C2)
IEC 62271-102	Disconnectors and earthing switches (E2, M0)
IEC 62271-200	Metal enclosed switchgear and controlgear
IEC 60044-1	Current transformers
IEC 60044-2	Voltage transformers
IEC 60529	Degrees of protection (IP Code)
IEC 61850	Communication networks and systems in substations
IEC 61243-5	Live working - voltage detectors - Part 5: voltage detecting systems

Product range

The xGear product range is very flexible and has a variety of circuit options that enable almost all types of application to be configured.

The truck design is common for all the types enabling the reconfiguration of the panel while in service.

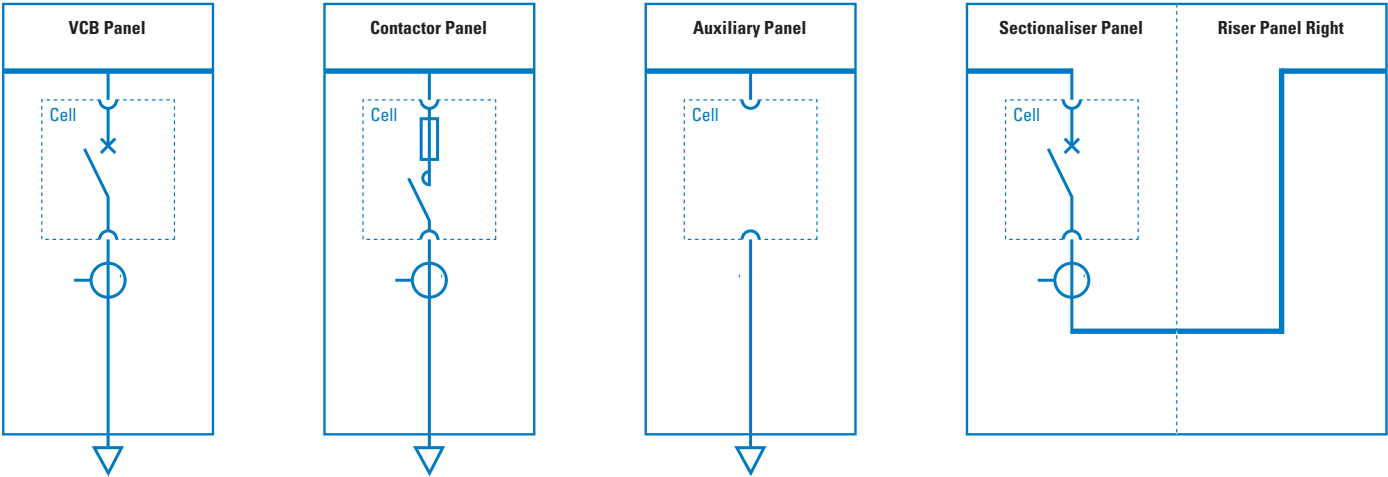
For added configuration flexibility the Riser Panels can be fitted on either the left or the right side of the Sectionaliser Panels. Also the width of the combination of

Sectionaliser and Riser Panels is kept to a minimum.

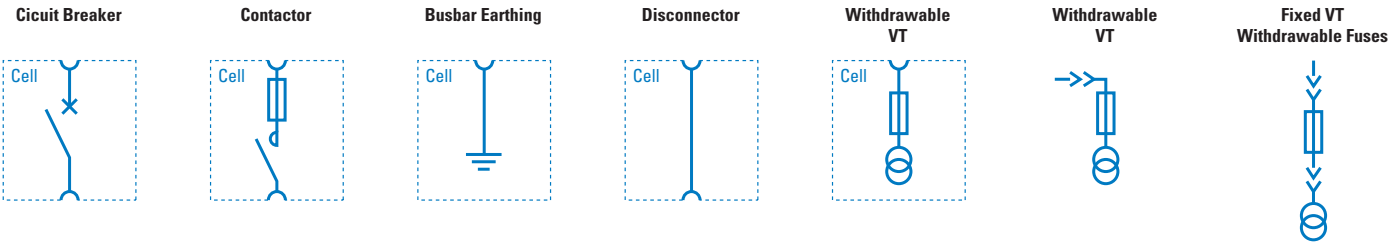
Further flexibility is provided by the Equipped Riser Panel option. In this configuration any standard equipment truck can be fitted into the Equipped Riser, offering options for busbar metering, earthing, and a disconnect truck.

A wide range of additional options are also available for mounting within the main primary compartments. The low voltage control and protection compartment also offers many options for control and indication.

Panel configurations



Truck configurations



Electrical Data

System		12 kV	17.5 kV
Rated voltage	kV	12	17.5
Lightning impulse withstand voltage	kV	75	95
Power frequency withstand voltage	kV	28	38
Rated frequency	Hz	50/60	50/60
Internal arc class			AFLR
Loss of service continuity category			LSC2B
Partition class			PM
Earthing circuit	kA - s	25 - 3; 26.3 - 3; 31.5 - 3	

Accessibility of compartments

Circuit breaker compartment		Interlock-controlled
Busbar compartment		Tool-based/non-accessible
Cable compartment		Tool-based or Interlock-controlled
External degree of protection		IP4X
Internal degree of protection		IP2X
Installation		Indoor
Temperature classification	°C	-5 to +40
Relative humidity (max)	%	95

Busbar system

Rated normal current	A	1250, 1600, 2000, 2500, 3150
Rated short-time withstand current	kA - 3 s	25 / 26.3 / 31.5
Rated peak withstand current	kA/50 Hz	63 / 66 / 80
	kA/60 Hz	65 / / 82

Circuit breaker ratings

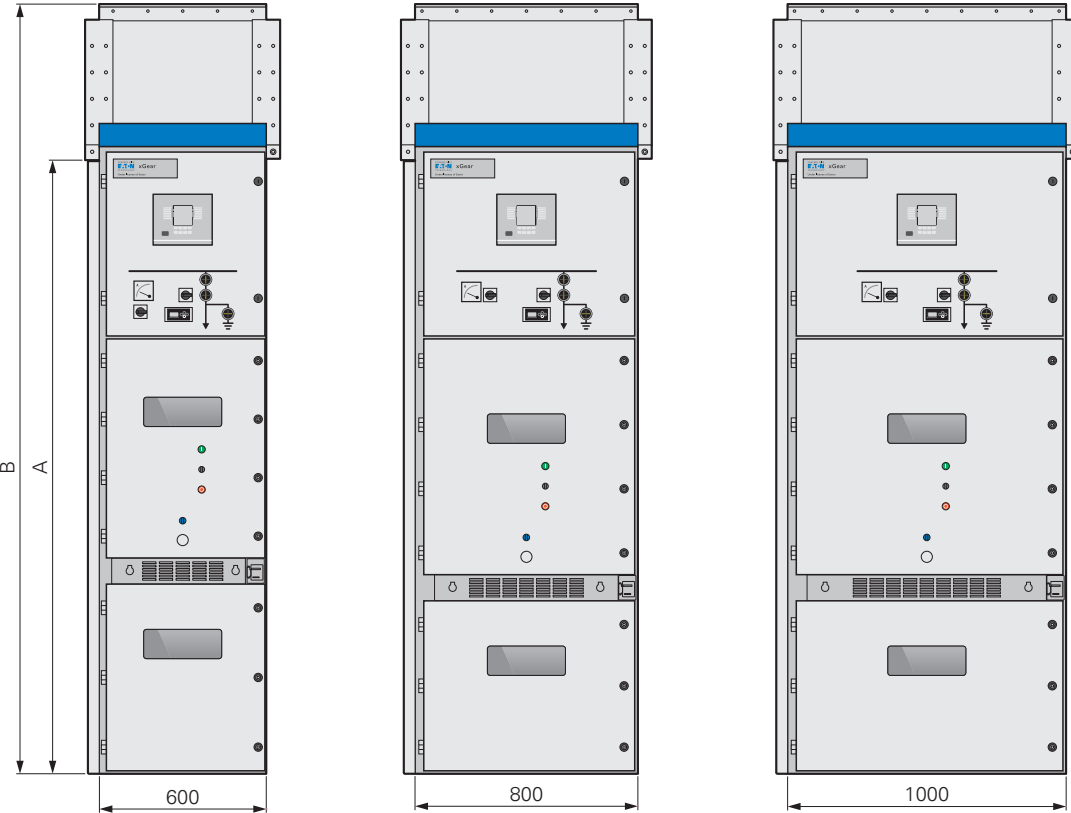
Rated normal current	A	630, 1250, 2000, 2500, 3150
Rated short-circuit breaking current	kA	26.3 / 31.5
Rated short-circuit making current	kA	65 / 82
Rated short-time withstand current	kA - 3 s	26.3 / 31.5
Single capacitor bank switching	C2 A	400
Multiple capacitor bank switching back to back	C1 A	400
Class		S1, E2
Auxiliary voltage	V	110/120/127 Vac 50/60Hz, 208/220/240 Vac 50/60Hz, 24/48/60 Vdc, 110/125 Vdc, 220/250 Vdc

Mechanism

Rated operating sequence	A	O - 0.3s - CO - 15s - CO [1] O - 0.3s - CO - 180s - CO [2]
Class		M2
Number of operations		up to 20,000
Number of operations interrupter		up to 20,000

[1] Operating sequence O - 0.3s - CO - 15s - CO is available on circuit breakers rated 12, 17.5 kV up to 2000 A.
[2] Operating sequence O - 0.3s - CO - 180s - CO is available on ALL circuit breakers rated 12 and 17.5 kV, ≥ 2500 A.

Dimensions (mm)



Panel width	600 mm	800 mm	1000 mm
12 kV and 17.5 kV			
Max. rating	630 A / 1250 A	2000 A	3150 A
Depth	1310	1320	1500
Height (A)	2200	2200	2200
Height including arc chamber (B)	2760	2760	2760

Weights (kg)

Circuit breaker panel			Max weight including circuit breaker
12 kV and 17.5 kV			
25 kA	630 A	600 mm wide	860
31.5 kA	1250 A	600 mm wide	880
31.5 kA	2000 A	800 mm wide	1200
31.5 kA	3150 A	1000 mm wide	1650

CUTLER-HAMMER

KLÖCKNER MOELLER

MEM

POWERWARE

BILL

FELTEN & GUILLEAUME

SANTAK

WESTINGHOUSE

MGE OFFICE PROTECTION SYSTEMS

CHANG SEN

MOELLER

HOLEC

EAT•N

The power of fusion.

1874

1886

1893

1899

1906

1908

1911

1962

1963

1983

1990

1998

1999

EAT•N

Powering Business Worldwide

There's a certain energy at Eaton. It's the power of uniting some of the world's most respected names to build a brand you can trust to meet every power management need. The energy created supports our commitment to powering business worldwide.

From power distribution to power quality and control, Eaton allows you to proactively manage your complete power system by providing electrical solutions that make your applications safer, more reliable, and highly efficient. Visit www.eaton.com/electrical.

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PowerChain™ solutions help enterprises achieve sustainable and competitive advantages through proactive management of the power system as a strategic, integrated asset throughout its life cycle, resulting in enhanced safety, greater reliability and energy efficiency. For more information, visit www.eaton.com/electrical.

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