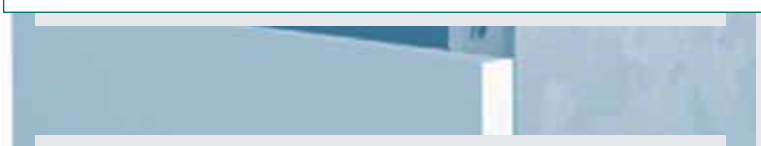
UniSafe

Medium voltage, air-insulated, arc proof switchgear for primary distribution



1 DESCRIPTION AND CHARACTERISTICS

Characteristics of UniSafe switchgear

- Metal-clad air-insulated switchboard
- Studied for medium voltage distribution
- Factory-tested for installations inside rooms
- Guaranteed arc-proof units
- Compartments segregated by means of metallic partitions openly connected to earth
- Limited use of insulating materials
- Complete with mechanical safety interlocks
- Structure made of pre-galvanised sheet
- Putting into service, maintenance and service operations can be carried out from the front
- Complete set of apparatus: gas and vacuum circuit breakers, contactors and switch disconnectors

- Equipped with conventional instrument transformers or new generation sensors
- Wide range of functional units for any all installation solutions
- Easy-to-assemble modular structure.

Transport
- Airports
- Port installations
- Railways
- Underground railways.

Service sector
- Supermarkets
- Shopping malls
- Hospitals
- Large infrastructures.

Applications

Utilities and Power Plants
- Power generation stations
- Transformer stations
- Switching stations
- Main and auxiliary switchgear.

Industry
- Pulp and Paper
- Textile
- Chemical
- Food
- Automotive
- Petrochemical.

1 DESCRIPTION AND CHARACTERISTICS

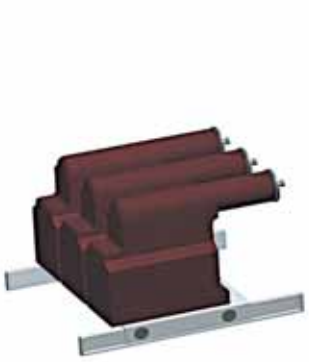
UniSafe is medium voltage metal-clad switchgear suitable for indoor installations.
The switchgear is modular and is made up by placing standardised units side by side in a coordinated way.
The unit compartments are metallically segregated from each other and the live parts are air insulated.

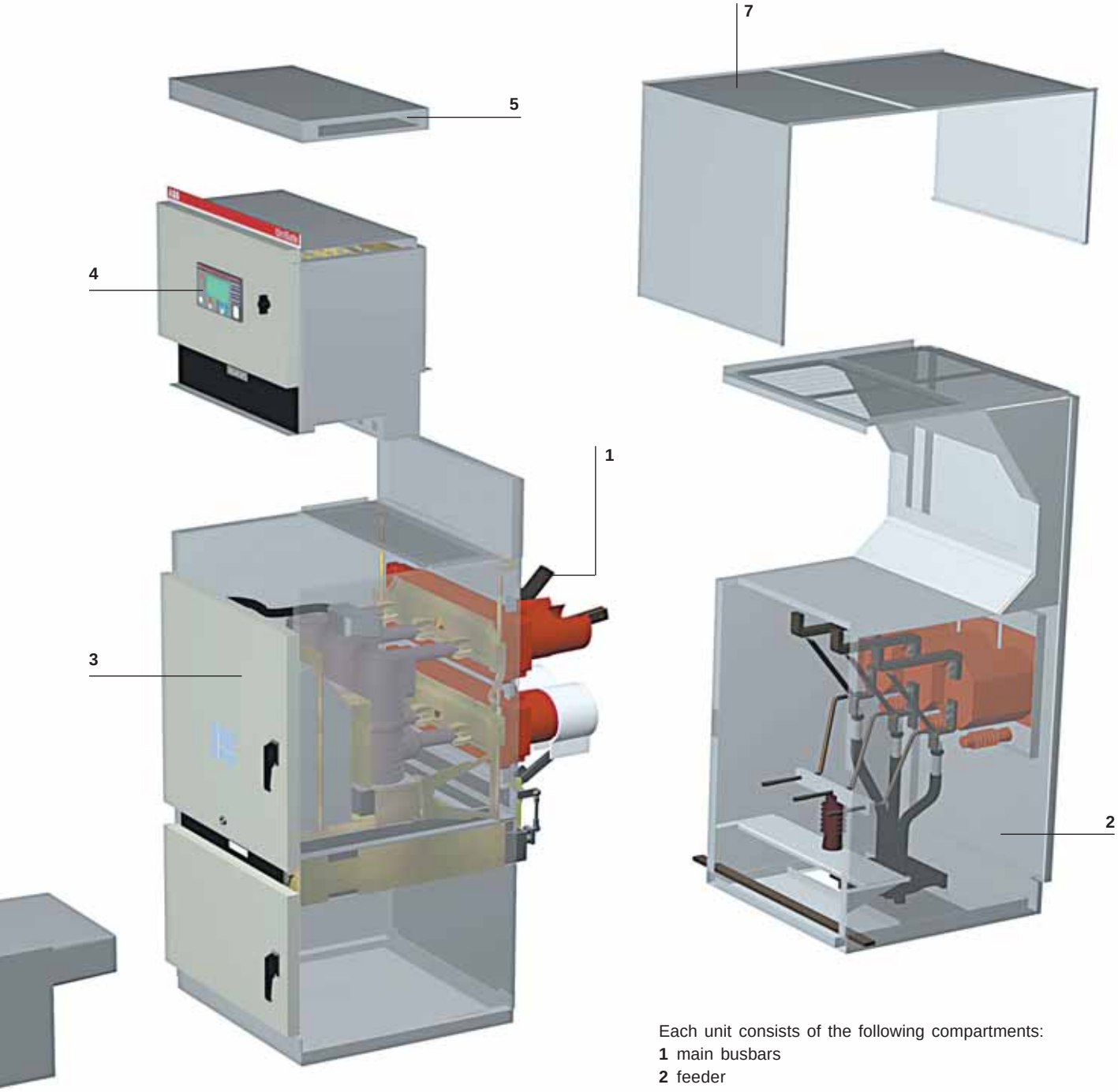
The switchgear functional units are guaranteed to be arc-proof in compliance with IEC 60298 Standards app. AA, class A accessibility, criteria 1 to 5.
Installation requires very simple civil works. The switchgear can be wall-mounted. Access to the branch connections to connect the power cables takes place from the front of the switchgear.

Electrical characteristics of the switchgear

The electrical characteristics of the switchgear can vary depending on environmental conditions other than those described and for degrees of protection higher than the standard values.

Rated voltage	kV	**12**	**17.5**	**24**
Rated insulation voltage	kV	12	17.5	24
Test voltage at power frequency	kV 1min	28	38	50
Impulse withstand voltage	kV	75	95	125
Rated frequency	Hz	50-60	50-60	50-60
Rated short-time withstand current	kA 1s	...50	...50	...25
Peak current	kA	...125	...125	...63
Rated short-time withstand current	kA 3s	...40	...40	...25
Peak current	kA	...100	...100	...63
Internal arc withstand current	kA 1s	...40	...40	...25
	kA 0.5s	...50	...50	–
Main busbar rated current	A	...4000	...4000	...2500
Rated current of the branch connections	A	630	630	630
		1250	1250	1250
		1600	1600	1600
		2000	2000	2000
		2500	2500	–
		3150	3150	–
Rated current of the branch connections	A	3600	3600	2500
with forced ventilation		4000	4000	–





Each unit consists of the following compartments:
1 main busbars
2 feeder
3 circuit-breaker
4 Instruments
5 Auxiliary circuit interconnection wiring duct
6 Withdrawable voltage transformers (on request)
7 Gas exhaust duct.

Electrical characteristics of the earthing switch

Rated voltage	kV	17,5 (*)	24 kV
Short-time withstand current / Short-circuit making capacity	kA	25 x 3s 31,5 x 3s 50 x 1s	... 25 x 3s ... 25 x 3s ... 25 x 3s
Peak current	kA	63 79 125	63

(*) Values also valid for 15 kV.

Degrees of protection

The degrees of protection of the switchgear comply with IEC 60529 / CEI EN 60529 Standards.
UniSafe switchgear are normally supplied with the following standard degrees of protection:

- external housing: IP4X
- inside the units: IP2X.

On request the external housing can be supplied with other degrees of protection up to a maximum of IP53.

Colour of the external surfaces

RAL7035.

Environmental conditions

The switchgear ratings are guaranteed under the following environmental conditions:

Minimum ambient temperature	– 5 °C
Maximum ambient temperature	+ 40 °C
Maximum relative humidity	95%
Maximum altitude	1000 m s.l.m.
In presence of unpolluted and non-corrosive atmosphere.	

Standards

The switchgear and the main apparatus it contains comply with the following Standards:

- IEC 60694 for general application
- IEC 62271-200 for the switchgear
- IEC 62271-102 for the earthing switch
- IEC 60071-2 for coordination of the insulation
- IEC 62271-100 for the circuit-breakers
- IEC 60470 for the contactor
- IEC 60265-1 for the switch-disconnector.

The IEC 62271-200 Standard has introduced new criteria regarding the definitions and classification of MV switchgear. One of the main changes introduced by this Standard is elimination of the classification of switchgear in metal-clad, divided into compartments and in units. The classification of switchgear has been reviewed taking into account the viewpoint of the user, particularly regarding some aspects such as operability and maintenance of the switchgear, according to the requirements and expectations of good management of substations, from installation to dismantling. In this context, the “loss of service continuity” has been chosen as the fundamental criterion for the user.

According to the updated standards, UniSafe switchgear can be defined as follows:

1. Compartment with access controlled by an interlock

Compartment containing high voltage parts, designed to be open for normal service and/or normal maintenance, where access is controlled by the overall configuration of the switchgear and by the control apparatus.

2. Compartment with access based on a procedure

Compartment containing high voltage parts, designed to be open for normal service and/or normal maintenance, where access is controlled by an adequate procedure associated with a locked status.

3. LSC2B

Busbar, feeder and apparatus compartments physically and electrically segregated.
This category defines the possibility of opening one of the main circuit compartments keeping the other compartments and/or function units energised.

4. Partition class

Metal-clad switchgear and control apparatus which offer continuous metallic segregations and/or shutters (if applicable),
destined to be earthed, among the freely accessed compartments and the live parts of the main circuit.
The metallic segregations and shutters or the metallic parts of these, must be connected to the earthing point of the functional unit.

Circuit-breakers

UniSafe Units can be equipped with withdrawable HD4 series gas and VD4 and VM1 series vacuum circuit-breakers.
The circuit-breakers are fitted with a truck for racking in and out of the switchgear with the door closed.

VD4 series vacuum circuit-breaker.

HD4 series gas circuit-breaker.

The light and compact structure of both types guarantees great sturdiness and excellent mechanical reliability.
The operating mechanism and the poles are fixed to the metallic structure which also acts as the support for the moving contact actuation kinetics.

VD4 and VM1 series vacuum circuit-breakers

The VD4 and VM1 circuit-breakers use vacuum as the interruption and insulating medium.
Thanks to the advanced techniques used for their construction, the VD4 and VM1 circuit-breakers ensure high performances under all service conditions.
The vacuum interrupters are embedded in the poles made of epoxy resin. This construction means the interrupters are unaffected by shocks, humidity and environmental pollution.
The circuit-breaker poles, making up the interruption part, are sealed for life pressure systems (IEC 62271-100 and CEI 17.1 Standards) and are maintenance-free.
The VD4 circuit-breakers use a mechanical type of operating mechanism, the VM1 circuit-breakers use an operating mechanism with a magnetic actuator.
They are both stored energy operating mechanisms with free trip and allow opening and closing operations independent of the operator's actions.

HD4 series gas circuit-breakers

The HD4 series of medium voltage circuit-breakers use sulphur hexafluoride gas (SF6) to extinguish the electric arc and as the insulating medium.
The breaking principle of HD4 circuit-breakers is based on compression and self-blast techniques to obtain top performances at all service current values, with gradual arc extinction, no restriking, operating overvoltages or chopped currents.
These characteristics guarantee long electrical life for the circuit-breaker and limited dynamic, dielectric and thermal stresses on the installation.
The circuit-breaker poles, which make up the interruption part, are sealed for life pressure systems (IEC 62271-100 and CEI 17.1 Standards) and are maintenance-free.
The stored energy mechanical operating mechanism has free trip and allows opening and closing operations independent of the operator's actions.

V-Contact series vacuum contactors.

V-Contact V/P and VSC/P series vacuum contactors

Use of V-Contact series withdrawable contactors is foreseen in the UniSafe units up to 12 kV.
The contactors are suitable for controlling alternating current users which require a high number of operations.
They consist of a resin monobloc where the vacuum interrupters, moving equipment, operating mechanism, multivoltage feeder and auxiliary accessories are housed.
The monobloc is also the support for installation of the fuses.
Fuses according to DIN or BS Standards of different dimensions can be used thanks to special adapters.
The type of fuseholder (BS or DIN) must be specified when ordering.
Contactor closing is prevented when even a single fuse is missing. Opening is automatic when one of the three fuses blows.
They are of compact and sturdy construction and guarantee very long electrical and mechanical life. The contactors are available in the version with electrical or mechanical latching.
Their construction is compact and sturdy and ensure very long electrical and mechanical life.

Service trucks

The UniSafe Units can be equipped with all the service trucks needed to complete the switchgear and required for service operations and during maintenance work.

The trucks are divided into four different types:
- earthing without making capacity.
- earthing with making capacity.
- cable testing.
- isolation.

Note: the earthing trucks with making and isolation capacity are derived from the HD4 series.

• **Earthing truck without making capacity "E"**

These trucks carry out the same function as the earthing switches without making capacity.
They therefore have no capacity to earth live circuits in fault conditions.
They are used to ensure an additional fixed earth, as is required by the installation service and maintenance procedures, as a further guarantee for personnel.
The use of these trucks foresees removal of the switching apparatus from the switchgear (circuit-breaker or contactor) and its replacement with the truck. The units preset for use of the earthing trucks are provided with a key lock which, when activated, prevents their racking-in.
They are available in two versions:

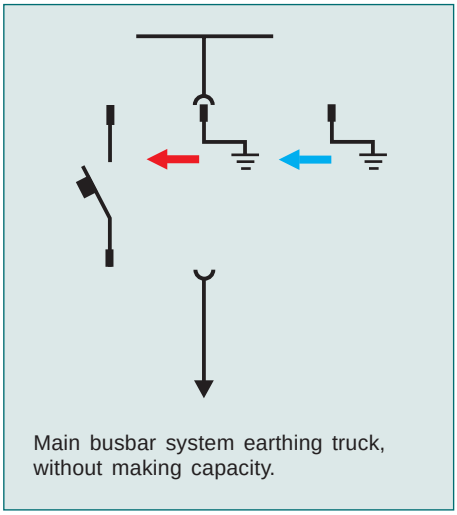
- earthing of the main busbar system (E/U series).
- earthing of the power cables (E/L series).

During the racking-in phase, the main busbar earthing truck only actuates the top shutter and earths the contacts connected to the top branch connections (and therefore to the main busbar system) by means of the switchgear structure.
During the racking-in phase, the power cable earthing truck only actuates the bottom shutter and earths the contacts connected to the bottom branch connections (and therefore to the power cables) by means of the switchgear structure.
These trucks can be used in incoming or outgoing units or in dedicated units.
They can also be used in bus-tie units. In this case, they earth one of the two sides of the main busbar system.

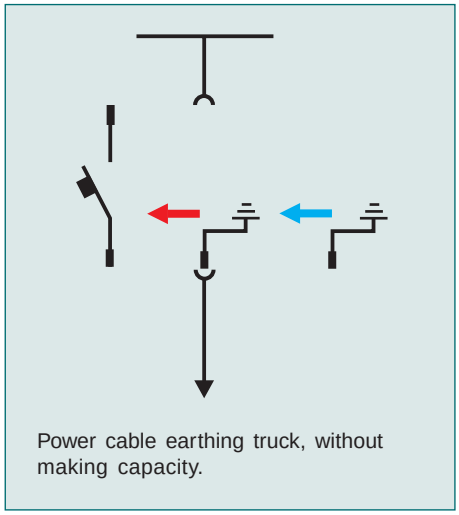
• **Earthing truck with making capacity "EM"**

These trucks carry out the same function as the earthing switches with making capacity.
They consist of circuit-breakers only fitted with top (main busbar earthing) or bottom (power cable earthing) terminals. The contacts without terminals are short-circuited by means of a copper bar and connected to earth by means of the apparatus truck.

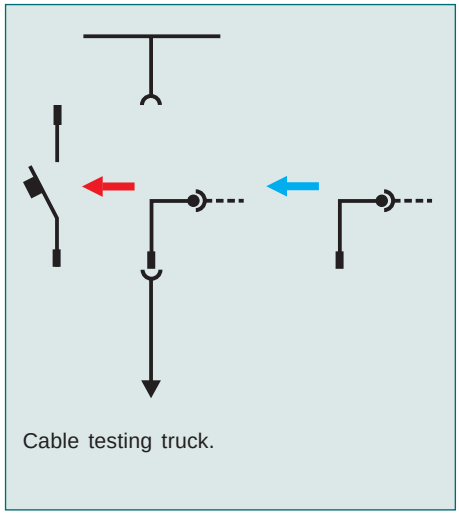
They keep all the characteristics of the circuit-breakers and full making capacity on live circuits under fault conditions.
They allow closing operations to be carried out rapidly with remote electric control.
The use of these trucks foresees removal of the switching apparatus from the switchgear (circuit-breaker or contactor) and its replacement with the truck. The units preset for use of the earthing trucks are provided with a key lock which, when activated, prevents their racking-in.



Main busbar system earthing truck, without making capacity.



Power cable earthing truck, without making capacity.



Cable testing truck.

They are available in two versions:
- main busbar system earthing (EM/U series)
- power cable earthing (EM/L series).

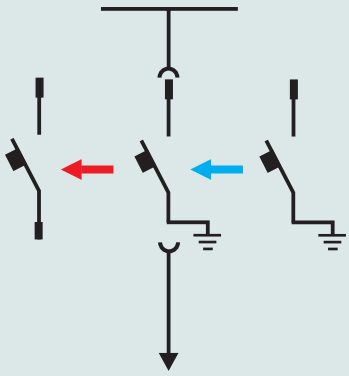
During the racking-in phase, the main busbar earthing truck only lifts the top shutter and prepares the contacts connected to the top branch connections (and therefore to the main busbar system) to close to earth by means of a control.
During the racking-in phase, the power cable earthing truck only lifts the bottom shutter and prepares the contacts connected to the bottom branch connections (and therefore to the power cables) to close to earth by means of a control.
These trucks can be used in incoming or outgoing units or in dedicated units.
They can also be used in bus-tie units. In this case, they earth one of the two sides of the main busbar system.

- **Power cable testing truck "T"**

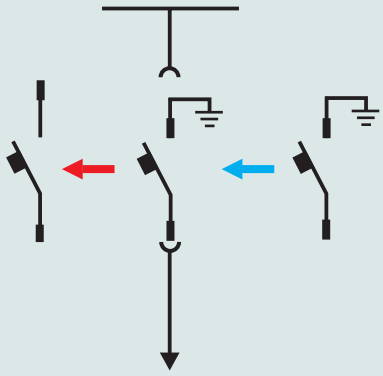
These trucks allow the insulation tests on the power cables to be carried out without accessing the feeder compartment or disconnecting the cables from the switchgear. The use of these trucks foresees removal of the switching apparatus from the switchgear (circuit-breaker or contactor) and its replacement with the truck.
During the racking-in phase, the truck only lifts the bottom shutter and, by means of the connectors it is fitted with, allows connection of the test apparatus cables by means of a special insulating rod (testing apparatus and insulating rod must be
provided by the customer).
This truck can only be used in incoming/outgoing units.

- **Isolating truck "S"**

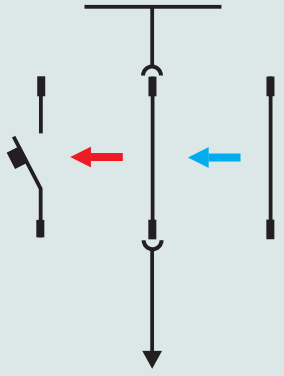
These trucks allow the top switchgear contacts to be connected directly to the bottom ones. Connection is made extremely safe by using the poles of the circuit-breakers to insulate the connection busbars from the external environment.
In the incoming/outgoing units, the isolating truck connects the main busbar system to the power cables, whereas in the bus-tie units, it connects the two sides of the busbar system.
These trucks have their application in switchgear for making incoming/outgoing units without a circuit-breaker in radial networks, for making cable connections between two switchgear placed in front of each other, in making interconnection units and in creating bus-tie-riser units with double isolation (in this case, both units are made up of bus-ties, the former fitted with a circuit-breaker and the latter with an isolating truck).
The units preset for using isolating trucks are fitted with a key lock which, when activated, prevents their being racked-in.



Main busbar system earthing truck, with making capacity.



Power cable earthing truck, with making capacity.



Isolating truck.

2 APPARATUS AND TYPES AVAILABLE

Table 1 -VD4 withdrawable circuit-breakers for UniSafe units (*)

			Rated current of the VD4 circuit-breakers (A - 40 °C)							
kV	**Isc (kA)**	**Icw (kA)**	W=600 p=150 u/l=205 H=260 ø=35	W=750 p=210 u/l=310 H=280 ø=35	W=750 p=210 u/l=310 H=280 ø=79	W=1000 p=275 u/l=310 H=280 ø=109	W=750 p=210 u/l=310 H=325 ø=35	W=1000 p=275 u/l=310 H=345 ø=79	**Circuit-breaker**	
12-17.5	16	16	630						VD4/P 12.06.16 p150	VD4/P 17.06.16 p150
	20	20	630						VD4/P 12.06.20 p150	VD4/P 17.06.20 p150
	25	25	630						VD4/P 12.06.25 p150	VD4/P 17.06.25 p150
	31.5	31.5	630						VD4/P 12.06.32 p150	VD4/P 17.06.32 p150
	16	16	1250						VD4/P 12.12.16 p150	VD4/P 17.12.16 p150
	20	20	1250						VD4/P 12.12.20 p150	VD4/P 17.12.20 p150
	25	25	1250						VD4/P 12.12.25 p150	VD4/P 17.12.25 p150
	31.5	31.5	1250						VD4/P 12.12.32 p150	VD4/P 17.12.32 p150
	16	16		630					VD4/W 12.06.16 p210	VD4/W 17.06.16 p210
	20	20		630					VD4/W 12.06.20 p210	VD4/W 17.06.20 p210
	25	25		630					VD4/W 12.06.25 p210	VD4/W 17.06.25 p210
	31.5	31.5		630					VD4/W 12.06.32 p210	VD4/W 17.06.32 p210
	16	16		1250					VD4/W 12.12.16 p210	VD4/W 17.12.16 p210
	20	20		1250					VD4/W 12.12.20 p210	VD4/W 17.12.20 p210
	25	25		1250					VD4/W 12.12.25 p210	VD4/W 17.12.25 p210
	31.5	31.5		1250					VD4/W 12.12.32 p210	VD4/W 17.12.32 p210
	40	40		1250					–	–
	50	50		1250					–	–
	40	40			1250				VD4/P 12.12.40 p210	VD4/P 17.12.40 p210
	50	50			1250				VD4/P 12.12.50 p210	–
	20	20			1600				VD4/P 12.16.20 p210	VD4/P 17.16.20 p210
	25	25			1600				VD4/P 12.16.25 p210	VD4/P 17.16.25 p210
	31.5	31.5			1600				VD4/P 12.16.32 p210	VD4/P 17.16.32 p210
	40	40			1600				VD4/P 12.16.40 p210 (1)	VD4/P 17.16.40 p210 (1)
	50	50			1600				VD4/P 12.16.50 p210 (1)	–
	20	20			2000				VD4/P 12.20.20 p210	VD4/P 17.20.20 p210
	25	25			2000				VD4/P 12.20.25 p210	VD4/P 17.20.25 p210
	31.5	31.5			2000				VD4/P 12.20.32 p210	VD4/P 17.20.32 p210
	40	40			2000				VD4/P 12.20.40 p210 (1)	VD4/P 17.20.40 p210 (1)
	50	50			2000				VD4/P 12.20.50 p210 (1)	–
	20	20				2500			VD4/P 12.25.20 p275	VD4/P 17.25.20 p275
	25	25				2500			VD4/P 12.25.25 p275	VD4/P 17.25.25 p275
	31.5	31.5				2500			VD4/P 12.25.32 p275	VD4/P 17.25.32 p275
	40	40				2500			VD4/P 12.25.40 p275 (1)	VD4/P 17.25.40 p275 (1)
	50	50				2500			VD4/P 12.25.50 p275 (1)	–
	31.5	31.5				3150			VD4/P 12.32.32 p275 (1)	VD4/P 17.32.32 p275 (1)
	40	40				3150			VD4/P 12.32.40 p275 (1)	VD4/P 17.32.40 p275 (1)
	50	50				3150			VD4/P 12.32.50 p275 (1)	–
	31.5	31.5				3600			VD4/P 12.32.32 p275 (1)	VD4/P 17.32.32 p275 (1)
	40	40				3600			VD4/P 12.32.40 p275 (1)	VD4/P 17.32.40 p275 (1)
	50	50				3600			VD4/P 12.32.50 p275 (1)	–
	31.5	31.5				4000			VD4/P 12.32.32 p275 (1)	VD4/P 17.32.32 p275 (1)
	40	40				4000			VD4/P 12.32.40 p275 (1)	VD4/P 17.32.40 p275 (1)
	50	50				4000			VD4/P 12.32.50 p275 (1)	–
24	16	16					630		VD4/P 24.06.16 p210	–
	20	20					630		VD4/P 24.06.20 p210	–
	25	25					630		VD4/P 24.06.25 p210	–
	16	16					1250		VD4/P 24.12.16 p210	–
	20	20					1250		VD4/P 24.12.20 p210	–
	25	25					1250		VD4/P 24.12.25 p210	–
	16	16						1600	VD4/P 24.16.16 p275	–
	20	20						1600	VD4/P 24.16.20 p275	–
	25	25						1600	VD4/P 24.16.25 p275	–
	16	16						2000	VD4/P 24.20.16 p275	–
	20	20						2000	VD4/P 24.20.20 p275	–
	25	25						2000	VD4/P 24.20.25 p275	–
	16	16						2500	VD4/P 24.25.16 p275	–
	20	20						2500	VD4/P 24.25.20 p275	–
	25	25						2500	VD4/P 24.25.25 p275	–

W = Width of unit.
P = Horizontal centre distance between circuit-breaker poles.
U/L = Distance between top and bottom terminal.
H = Distance between bottom terminal and earth
Ø = Diameter of the contacts in the UniSafe unit monbloc.
(*) The UniSafe units are not prepared for application of the “motorised truck” for VD4 circuit-breakers.
(1) Please ask ABB for availability.

Table 2 - Withdrawable HD4 circuit-breakers for UniSafe units

			Rated current of the HD4 circuit-breakers (A - 40 °C)							
kV	**Isc (kA)**	**Icw (kA)**	W=600 p=150 u/l=205 H=260 ø=35	W=750 p=210 u/l=310 H=280 ø=35	W=750 p=210 u/l=310 H=280 ø=79	W=1000 p=275 u/l=310 H=280 ø=109	W=750 p=210 u/l=310 H=325 ø=35	W=1000 p=275 u/l=310 H=345 ø=79	**Circuit-breaker**	
12	16	16	630						HD4/W 12.06.16 p150	HD4/W 17.06.16 p150
17.5	25	25	630						HD4/W 12.06.25 p150	HD4/W 17.06.25 p150
	31.5	31.5	630						HD4/W 12.06.32 p150	HD4/W 17.06.32 p150
	16	16	1250						HD4/W 12.12.16 p150	HD4/W 17.12.16 p150
	25	25	1250						HD4/W 12.12.25 p150	HD4/W 17.12.25 p150
	31.5	31.5	1250						HD4/W 12.12.32 p150	HD4/W 17.12.32 p150
	16	16		630					HD4/W 12.06.16 p210	HD4/W 17.06.16 p210
	25	25		630					HD4/W 12.06.25 p210	HD4/W 17.06.25 p210
	31.5	31.5		630					HD4/W 12.06.32 p210	HD4/W 17.06.32 p210
	16	16		1250					HD4/W 12.12.16 p210	HD4/W 17.12.16 p210
	25	25		1250					HD4/W 12.12.25 p210	HD4/W 17.12.25 p210
	31.5	31.5		1250					HD4/W 12.12.32 p210	HD4/W 17.12.32 p210
	40	40		1250					HD4/W 12.12.40 p210	HD4/W 17.12.40 p210
	50	50		1250					HD4/W 12.12.50 p210	HD4/W 17.12.50 p210
	40	40			1250				--	--
	50	50			1250				--	--
	16	16			1600				HD4/W 12.16.16 p210	HD4/W 17.16.16 p210
	25	25			1600				HD4/W 12.16.25 p210	HD4/W 17.16.25 p210
	31.5	31.5			1600				HD4/W 12.16.32 p210	HD4/W 17.16.32 p210
	40	40			1600				HD4/P 12.16.40 p210	HD4/P 17.16.40 p210
	50	50			1600				HD4/P 12.16.50 p210	HD4/P 17.16.50 p210
	16	16			2000				HD4/W 12.20.16 p210	HD4/W 17.20.16 p210
	25	25			2000				HD4/W 12.20.25 p210	HD4/W 17.20.25 p210
	31.5	31.5			2000				HD4/W 12.20.32 p210	HD4/W 17.20.32 p210
	40	40			2000				HD4/P 12.20.40 p210	HD4/P 17.20.40 p210
	50	50			2000				HD4/P 12.20.50 p210	HD4/P 17.20.50 p210
	25	25				2500			HD4/P 12.25.25 p275	HD4/P 17.25.25 p275
	31.5	31.5				2500			HD4/P 12.25.32 p275	HD4/P 17.25.32 p275
	40	40				2500			HD4/P 12.25.40 p275	HD4/P 17.25.40 p275
	50	50				2500			HD4/P 12.25.50 p275	HD4/P 17.25.50 p275
	31.5	31.5				3150			HD4/W 12.32.32 p275	HD4/W 17.32.32 p275
	40	40				3150			HD4/W 12.32.40 p275	HD4/W 17.32.40 p275
	50	50				3150			HD4/W 12.32.50 p275	HD4/W 17.32.50 p275
	31.5	31.5				3600			HD4/W 12.32.32 p275	HD4/W 17.32.32 p275
	40	40				3600			HD4/W 12.32.40 p275	HD4/W 17.32.40 p275
	50	50				3600			HD4/W 12.32.50 p275	HD4/W 17.32.50 p275
	31.5	31.5				4000			HD4/W 12.32.32 p275	HD4/W 17.32.32 p275
	40	40				4000			HD4/W 12.32.40 p275	HD4/W 17.32.40 p275
	50	50				4000			HD4/W 12.32.50 p275	HD4/W 17.32.50 p275
24	16	16					630		HD4/W 24.06.16 p210	--
	20	20					630		HD4/W 24.06.20 p210	--
	25	25					630		HD4/W 24.06.25 p210	--
	16	16					1250		HD4/W 24.12.16 p210	--
	20	20					1250		HD4/W 24.12.20 p210	--
	25	25					1250		HD4/W 24.12.25 p210	--
	16	16						1600	HD4/P 24.16.16 p275	--
	20	20						1600	HD4/P 24.16.20 p275	--
	25	25						1600	HD4/P 24.16.25 p275	--
	16	16						2000	HD4/P 24.20.16 p275	--
	20	20						2000	HD4/P 24.20.20 p275	--
	25	25						2000	HD4/P 24.20.25 p275	--
	16	16						2500	HD4/P 24.25.16 p275	--
	20	20						2500	HD4/P 24.25.20 p275	--
	25	25						2500	HD4/P 24.25.25 p275	--

W = Width of unit.
P = Horizontal centre distance between circuit-breaker poles.
U/L = Distance between top and bottom terminal.
H = Distance between bottom terminal and earth
Ø = Diameter of the contacts in the unit monbloc.

Table 3 - Withdrawable VM1 circuit-breakers for UniSafe units

			Rated current of the VM1 circuit-breakers (A - 40 °C)							
kV	**Isc (kA)**	**Icw (kA)**	W=600 p=150 u/l=205 H=260 ø=35	W=750 p=210 u/l=310 H=280 ø=35	W=750 p=210 u/l=310 H=280 ø=79	W=1000 p=275 u/l=310 H=280 ø=109	W=750 p=210 u/l=310 H=325 ø=35	W=1000 p=275 u/l=310 H=345 ø=79	**Circuit-breaker**	
12	16	16	630						VM1/P 12.06.16 p150	VM1/P 17.06.16 p150
17.5	20	20	630						VM1/P 12.06.20 p150	VM1/P 17.06.20 p150
	25	25	630						VM1/P 12.06.25 p150	VM1/P 17.06.25 p150
	31.5	31.5	630						VM1/P 12.06.32 p150	VM1/P 17.06.32 p150
	16	16	1250						VM1/P 12.12.16 p150	VM1/P 17.12.16 p150
	20	20	1250						VM1/P 12.12.20 p150	VM1/P 17.12.20 p150
	25	25	1250						VM1/P 12.12.25 p150	VM1/P 17.12.25 p150
	31.5	31.5	1250						VM1/P 12.12.32 p150	VM1/P 17.12.32 p150
	16	16		630					VM1/W 12.06.16 p210	VM1/W 17.06.16 p210
	20	20		630					VM1/W 12.06.20 p210	VM1/W 17.06.20 p210
	25	25		630					VM1/W 12.06.25 p210	VM1/W 17.06.25 p210
	31.5	31.5		630					VM1/W 12.06.32 p210	VM1/W 17.06.32 p210
	16	16		1250					VM1/W 12.12.16 p210	VM1/W 17.12.16 p210
	20	20		1250					VM1/W 12.12.20 p210	VM1/W 17.12.20 p210
	25	25		1250					VM1/W 12.12.25 p210	VM1/W 17.12.25 p210
	31.5	31.5		1250					VM1/W 12.12.32 p210	VM1/W 17.12.32 p210
	40	40		1250					--	--
	50	50		1250					--	--
	40	40			1250				--	
	50	50			1250					
	20	20			1600				VM1/P 12.16.20 p210	VM1/P 17.16.20 p210
	25	25			1600				VM1/P 12.16.25 p210	VM1/P 17.16.25 p210
	31.5	31.5			1600				VM1/P 12.16.32 p210	VM1/P 17.16.32 p210
	40	40			1600				--	
	50	50			1600					
	20	20			2000				VM1/P 12.20.20 p210	VM1/P 17.20.20 p210
	25	25			2000				VM1/P 12.20.25 p210	VM1/P 17.20.25 p210
	31.5	31.5			2000				VM1/P 12.20.32 p210	VM1/P 17.20.32 p210
	40	40			2000				--	
	50	50			2000					
	20	20				2500			VM1/P 12.25.20 p275	VM1/P 17.25.20 p275
	25	25				2500			VM1/P 12.25.25 p275	VM1/P 17.25.25 p275
	31.5	31.5				2500			VM1/P 12.25.32 p275	VM1/P 17.25.32 p275
	40	40				2500			–	
	50	50				2500				
	31.5	31.5				3150				
	40	40				3150				
	50	50				3150				
	31.5	31.5				3600			–	–
	40	40				3600				
	50	50				3600				
	31.5	31.5				4000			–	–
	40	40				4000				
	50	50				4000				
24	16	16					630		VM1/P 24.06.16 p210	
	20	20					630		VM1/P 24.06.20 p210	
	25	25					630		VM1/P 24.06.25 p210	
	16	16					1250		VM1/P 24.12.16 p210	
	20	20					1250		VM1/P 24.12.20 p210	
	25	25					1250		VM1/P 24.12.25 p210	
	16	16						1600	VM1/P 24.16.16 p275	
	20	20						1600	VM1/P 24.16.20 p275	
	25	25						1600	VM1/P 24.16.25 p275	
	16	16						2000	VM1/P 24.20.16 p275	
	20	20						2000	VM1/P 24.20.20 p275	
	25	25						2000	VM1/P 24.20.25 p275	
	16	16						2500	VM1/P 24.25.16 p275	
	20	20						2500	VM1/P 24.25.20 p275	
	25	25						2500	VM1/P 24.25.25 p275	

W = Width of unit.
P = Horizontal centre distance between circuit-breaker poles.
U/L = Distance between top and bottom terminal.
H = Distance between bottom terminal and earth
Ø = Diameter of the contacts in the unit monbloc.

Table 4 - V-Contact withdrawable contactors for UniSafe units

			Rated current of the V-Contact contactors (A - 40 °C)						
kV	**Isc (kA)**	**Icw (kA)**	W=600 p=150 u/l=205 H=260 ø=35	W=750 p=210 u/l=310 H=280 ø=35	W=750 p=210 u/l=310 H=280 ø=79	W=1000 p=275 u/l=310 H=280 ø=109	W=750 p=210 u/l=310 H=325 ø=35	W=1000 p=275 u/l=310 H=345 ø=79	**Contactor**
7.2	16	6	400						V7/W
	20	6	400						VSC7/P
	25	6	400						
	31.5	6	400						
12	16	6	400						V12/W
	20	6	400						VSC12/P
	25	6	400						
	31.5	6	400						

W = Width of unit.
P = Horizontal centre distance between circuit-breaker poles.
U/L = Distance between top and bottom terminal.
H = Distance between bottom terminal and earth
Ø = Diameter of the contacts in the unit monbloc.

Table 5 - Isolating trucks with making capacity for UniSafe units

			Rated current of the isolating trucks (A - 40 °C)						
kV	**Isc (kA)**	**Icw (kA)**	W=600 p=150 u/l=205 H=260 ø=35	W=750 p=210 u/l=310 H=280 ø=35	W=750 p=210 u/l=310 H=280 ø=79	W=1000 p=275 u/l=310 H=280 ø=109	W=750 p=210 u/l=310 H=325 ø=35	W=1000 p=275 u/l=310 H=345 ø=79	**Isolating truck**
12 **17.5**	16 20 25 31.5	16 20 25 31.5	...1250						S-HD4/W 17.12.32 p150
	16 20 25 31.5 40 50	16 20 25 31.5 40 50		...1250					S-HD4/W 17.12.32 p210
									S-HD4/W 17.12.50 p210
	16 20 25 31.5 40 50	16 20 25 31.5 40 50			...2000				S-HD4/W 17.20.32 p210
									S-HD4/P 17.20.50 p210
	16 20 25 31.5 40 50	16 20 25 31.5 40 50				...2500			S-HD4/P 17.25.50 p275
	16 20 25 31.5 40 50	16 20 25 31.5 40 50				...3150			S-HD4/P 17.32.50 p275
	31.5 40 50	31.5 40 50				...3600 ...3600			S-HD4/P 17.32.50 p275
	31.5 40 50	31.5 40 50				...4000 ...4000			S-HD4/P 17.32.50 p275
24	16 20 25	16 20 25					...1250		S-HD4/W 24.12.25 p210
	16 20 25	16 20 25						...2000	S-HD4/P 24.20.25 p275
	16 20 25	16 20 25						...2500	S-HD4/P 24.25.25 p275

W = Width of unit.
P = Horizontal centre distance between circuit-breaker poles.
U/L = Distance between top and bottom terminal.
H = Distance between bottom terminal and earth
Ø = Diameter of the contacts in the unit monbloc.

Table 6 - Earthing trucks with making capacity for UniSafe units

			Rated current of the earthing trucks (A - 40 °C)						
kV	**Isc (kA)**	**Icw (kA)**	W=600 p=150 u/l=205 H=260 ø=35	W=750 p=210 u/l=310 H=280 ø=35	W=750 p=210 u/l=310 H=280 ø=79	W=1000 p=275 u/l=310 H=280 ø=109	W=750 p=210 u/l=310 H=325 ø=35	W=1000 p=275 u/l=310 H=345 ø=79	**Earthing truck (1)**
12 **17.5**	16 20 25 31.5	16 20 25 31.5	...1250						EM-U/W 17.12.32 p150 EM-L/W 17.12.32 p150
	16 20 25 31.5 40 50	16 20 25 31.5 40 50		...1250					EM-L/W 17.12.32 p210 EM-U/W 17.12.32 p210 EM-L/W 17.12.50 p210 (2) EM-U/W 17.12.50 p210 (2)
	16 20 25 31.5 40 50	16 20 25 31.5 40 50			...2000				EM-L/W 17.20.32 p210 EM-U/W 17.20.32 p210 EM-L/P 17.20.50 p210 EM-U/P 17.20.50 p210
	16 20 25 31.5 40 50	16 20 25 31.5 40 50				...2500			EM-L/P 17.25.50 p275 EM-U/P 17.25.50 p275
	16 20 25 31.5 40 50	16 20 25 31.5 40 50				3150			EM-L/P 17.32.50 p275 EM-U/P 17.32.50 p275
24	16 20 25	16 20 25					...1250		EM-L/W 24.12.25 p210 EM-U/W 24.12.25 p210
	16 20 25	16 20 25						...2000	EM-L/P 24.20.25 p275 EM-U/P 24.20.25 p275
	16 20 25	16 20 25						...2500 (2)	EM-L/P 24.25.25 p275 EM-U/P 24.25.25 p275

W = Width of unit.
P = Horizontal centre distance between circuit-breaker poles.
U/L = Distance between top and bottom terminal.
H = Distance between bottom terminal and earth
Ø = Diameter of the contacts in the unit monbloc.

(1) - EM-L... = Earthing truck with making capacity with bottom bushings (for cable earthing).
- EM-U... = Earthing truck with making capacity with top bushings (for earthing the busbar system).

(2) Ask ABB.

Table 7 - Earthing trucks without making capacity for UniSafe units

			Rated current of the earthing trucks (A - 40 °C)						
kV	**Isc (kA)**	**Icw (kA)**	W=600 p=150 u/l=205 H=260 ø=35	W=750 p=210 u/l=310 H=280 ø=35	W=750 p=210 u/l=310 H=280 ø=79	W=1000 p=275 u/l=310 H=280 ø=109	W=750 p=210 u/l=310 H=325 ø=35	W=1000 p=275 u/l=310 H=345 ø=79	**Earthing truck (1)**
12	16	16	...1250						
17.5	20	20							E-U/W 17.12.32 p150
	25	25							E-L/W 17.12.32 p150
	31.5	31.5							
	16	16		...1250					
	20	20							E-L/W 17.12.32 p210
	25	25							E-U/W 17.12.32 p210
	31.5	31.5							
	40	40							E-L/W 17.12.50 p210 (2)
	50	50							E-U/W 17.12.50 p210 (2)
	16	16			...2000				
	20	20							E-L/W 17.20.32 p210
	25	25							E-U/W 17.20.32 p210
	31.5	31.5							
	40	40							E-L/P 17.20.50 p210
	50	50							E-U/P 17.20.50 p210
	16	16				...2500			
	20	20							
	25	25							E-L/P 17.25.50 p275
	31.5	31.5							E-U/P 17.25.50 p275
	40	40							
	50	50							
	16	16				...3150			
	20	20							
	25	25							E-L/P 17.32.50 p275
	31.5	31.5							E-U/P 17.32.50 p275
	40	40							
	50	50							
24	16	16					...1250		
	20	20							E-L/W 24.12.25 p210
	25	25							E-U/W 24.12.25 p210
	16	16						...2000	
	20	20							E-L/P 24.20.25 p275
	25	25							E-U/P 24.20.25 p275
	16	16						...2500	
	20	20							E-L/P 24.25.25 p275
	25	25							E-U/P 24.25.25 p275

W = Width of unit.
P = Horizontal centre distance between circuit-breaker poles.
U/L = Distance between top and bottom terminal.
H = Distance between bottom terminal and earth
Ø = Diameter of the contacts in the unit monbloc.

(1) - EM-L... = Earthing truck without making capacity with bottom bushings (for cable earthing).
- EM-U... = Earthing truck without making capacity with top bushings (for earthing the busbar system).

(2) Ask ABB.

Table 8 - Cable testing trucks for UniSafe units

kV	Isc (kA)	Icw (kAx3s)	W=600 p=150 u/l=205 H=260 ø=35	W=750 p=210 u/l=310 H=280 ø=35	W=750 p=210 u/l=310 H=280 ø=79	W=1000 p=275 u/l=310 H=280 ø=109	W=750 p=210 u/l=310 H=325 ø=35	W=1000 p=275 u/l=310 H=345 ø=79	**Cable testing truck**
12	16	16	...1250						T/W 17.12 p150
17.5	20	20							
	25	25							
	31.5	31.5							
	16	16		...1250					T/W 17.12 p210
	20	20							
	25	25							
	31.5	31.5							
	40	40							T/W 17.12 p210 (1)
	50	50							
	16	16			...2000				T/W 17.20 p210
	20	20							
	25	25							
	31.5	31.5							
	40	40							T/P 17.20 p210
	50	50							
	16	16				2500			T/P 17.32 p275
	20	20							
	25	25							
	31.5	31.5							
	40	40							
	50	50							
	16	16				3150			
	20	20							
	25	25							
	31.5	31.5							
	40	40							
	50	50							
24	16	16					...1250		T/W 24.12 p210
	20	20							
	25	25							
	16	16						...2000	T/W 24.20 p275
	20	20							
	25	25							
	16	16						...2500 (1)	T/P 24.25 p275
	20	20							
	25	25							

W = Width of unit.
P = Horizontal centre distance between circuit-breaker poles.
U/L = Distance between top and bottom terminal.
H = Distance between bottom terminal and earth

Ø = Diameter of the contacts in the unit monbloc.
(1) Ask ABB.

Compartments

Each unit consists of three power compartments: busbars, feeder and circuit-breaker, and of three auxiliary compartments: instruments, auxiliary circuit interconnection wiring duct and voltage transformers (in the units where this application is foreseen).
The arc proof switchgear is also fitted with a duct to evacuate the gases produced by a possible internal arc. All the compartments are metallically segregated from each other.

Main busbars

The busbar compartment houses the main busbar system, which is connected to the circuit-breaker fixed isolating contacts by means of branch connections.
The main busbars are made of electrolytic copper. Up to 24 kV the system is made of flat copper bars, which can be covered with insulating material on request.

Branch connections

The feeder compartment houses the branch connection system to connect the power cables to the fixed isolating contacts of the circuit-breaker.
The branch connections are made of electrolytic copper.
Up to 24 kV the system is made of flat copper bars, which can be covered with insulating material on request.

Earthing switch

Each incoming/outgoing feeder unit can be fitted with an earthing switch to earth the cables.
The same device can also be used to earth the busbar system (measuring, bus-tie and riser units). The earthing switch is fitted with short-circuit making capacity.
On Request, the opening and closing operations can be locked by means of key locks or padlocks.
Control of the earthing switch takes place from the front of the switchgear with manual operation suitably interlocked.

Earthing busbar

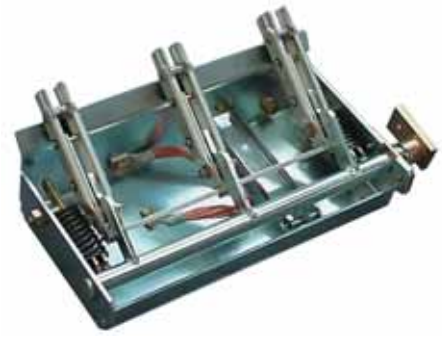
The earthing busbar is made of electrolytic copper. It runs longitudinally round the whole switchgear on the inside, thereby guaranteeing maximum safety for the personnel and for the installation.

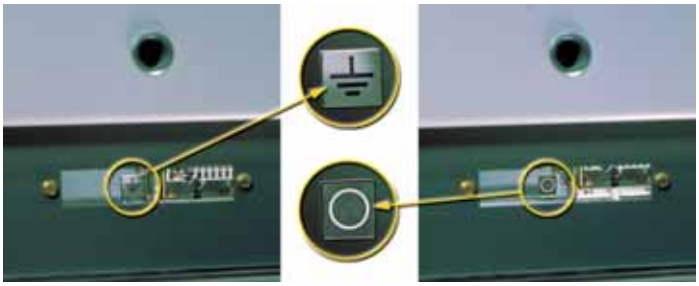
Monoblocs and shutters

The monoblocs consist of bushing insulators containing the top and bottom power connections of the circuit-breaker compartment, towards the feeder and busbar compartments respectively.
The shutters are of the metallic type and are automatically operated when the circuit-breaker moves from the isolated position to the connected position and vice versa.
They can be fitted with a fail-safe device (optional) to prevent their being manually opened with the circuit-breaker removed and the door open.
Each shutter can be locked using two independent padlocks (optional).

Cables

The switchgear can be installed against the walls in the substation because the cable compartment is easily accessible from the front as well.
Single-pole and three-pole cables can be used, up to a maximum of twelve per phase depending on the rated voltage, the dimensions of the unit and the cross-section of the cables.





Earthing switch. The position of the earthing switch (open - closed) can be seen from the outside through an inspection window.

Interlocks

The switchgear is fitted with all the interlocks needed to prevent incorrect operations which might jeopardise the safety of the personnel in charge of it.

In particular, locking devices are provided to prevent the following operations:
– circuit-breaker closing in an intermediate position
– circuit-breaker racking-out in the closed position
– circuit-breaker racking-in in the closed position
– circuit breaker compartment door opening in the connected or intermediate position
– circuit-breaker racking-in with the compartment door open.

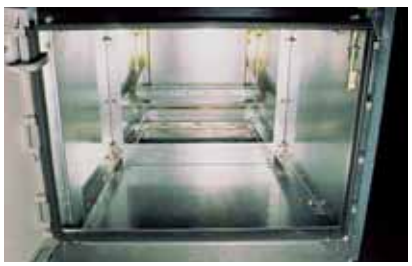
And if the unit is fitted with an earthing switch with the following as well:
– earthing switch closing with the circuit-breaker in the connected or intermediate position
– circuit-breaker racking-in with the earthing switch closed
– feeder compartment door opening with the earthing switch open
– earthing switch opening with the feeder compartment door open.

Main contacts of the circuit breaker compartment.

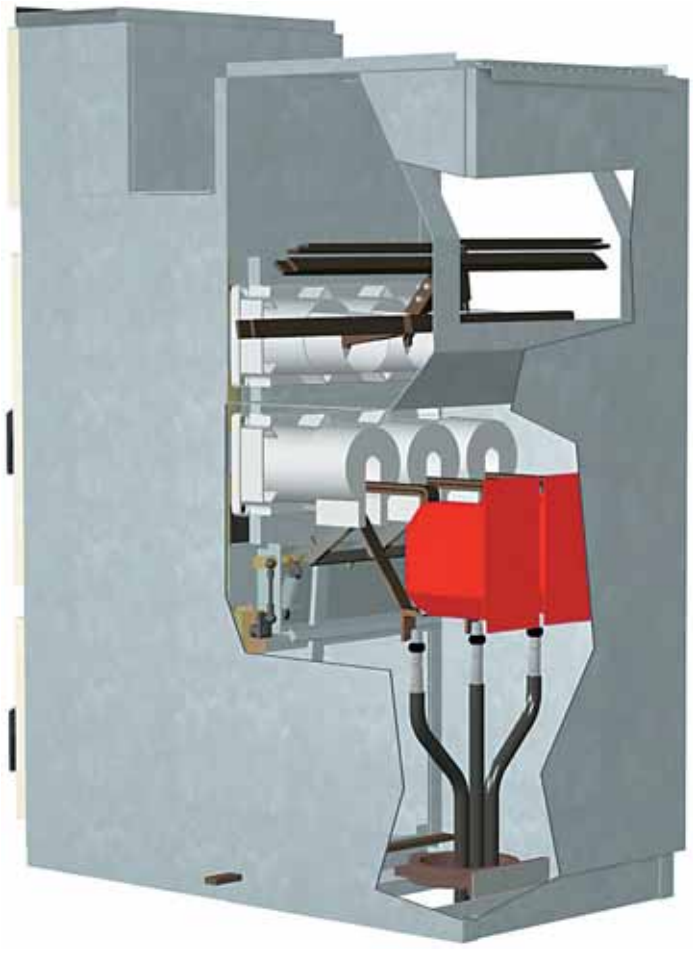
Metallic segregation shutters of the contacts.

Detail of metallic shutter earthing.

Feeder Compartment seen from above. The bottom monoblocs, current transformers and connection busbars can be seen.



View of the feeder compartment with the metallic segregation sheet removed.



4 INSTRUMENT TRANSFORMERS

Voltage transformers

The voltage transformers are of the type insulated in resin and are used for power supply to measuring instruments and protections. They are available either for fixed installation or mounted on withdrawable trucks.
They comply with IEC 60044-2 Standards.
The dimensions of the version used for fixed assembly comply with DIN 42600 Narrow type Standards. On the other hand, the ones installed on a withdrawable truck are the dedicated type.
These transformers can have one or two poles, with performances and classes of precision suited to the functional requirements of the instruments connected to them.
When they are installed on withdrawable trucks, they are fitted with medium voltage protection fuses. Fuse replacement can be carried out with the switchgear in service.

Current transformers

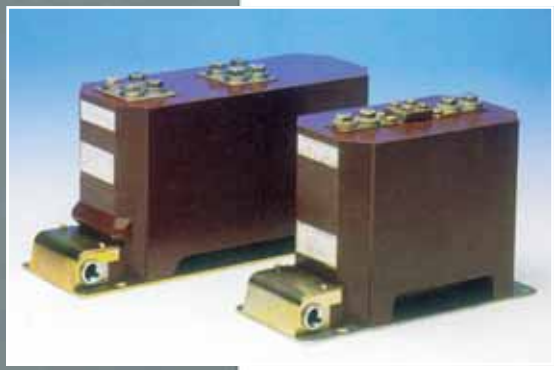
The current transformers are of the type insulated in resin and are used for power supply to measuring instruments and protections. These transformers can either have a wound core or a through bar with one or more cores, with performance and precision classes suited to the installation requirements.
They comply with IEC 60044-1 Standards.
Their dimensions are usually according to the DIN 42600 Narrow Type Standard, in the Medium and Long Size versions. The switchgear units can be equipped with one or two sets of three transformers.

The current transformers can also be fitted with a capacitive socket for connection to the voltage signalling lamps.

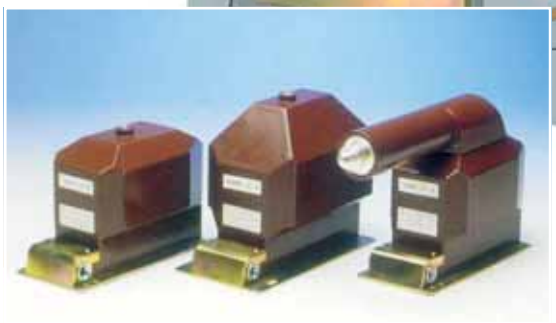
Toroidal current transformers

The toroidal current transformers are of the type insulated in resin and are used for power supply to measuring instruments and protections. These transformers can have a solid or split core, with performances and classes of precision suited to the installation requirements.
They can be used both for measuring phase currents and for determining the earth fault current. They
meet the requirements of IEC 60044-1 Standards.

Compartment with withdrawable voltage transformers.



Current transformers.



Voltage transformers.

Toroidal current transformer.

5 MEASUREMENT SENSORS

The introduction of digital technologies into electrical measuring and protection instruments has considerably modified the performances required of transformers.
The analog input levels of the instruments have been notably reduced when compared with those of traditional systems.
For this reason, ABB has introduced a new range of sensors which best covers the characteristics of the new generations of instruments
UniSafe switchgear can be equipped with ABB KEVCD Block Type sensors up to 24 kV.
The current sensors comply with the IEC 60044-8 (CDV) Standards, whereas the voltage sensors comply with the IEC 60044-7 Standards.
The dimensions are in accordance with the DIN 42600 Narrow Type standard.
Both the current and voltage sensors or just the current sensors can be integrated simultaneously in the same resin body. The voltage divider for connection to the voltage signalling lamps is also inserted.
The measurement sensors and the multi-purpose ABB units have Cl. 1 class of precision.

Current sensor

The current sensor consists of a Rogowski coil without the ferromagnetic core, so it is not affected by saturation phenomena.

When a coil is formed by a uniform winding over a closed non-magnetic core of constant cross-section, the induced voltage in the secondary circuit is directly proportional to the variation in the let-through current. To obtain a signal proportional to the current given, this voltage must be integrated. The multi-purpose devices carry out this function and use the signal obtained both for the measurements and for the protections.

Main characteristics of the current sensors

- linear response over the whole measurement range;
- no saturation phenomenon;
- no hysterisis phenomenon;
- a single instrument for protections and measurements;
- high class of precision;
- high degree of immunity to electromagnetic interferences;
- the output signal is a voltage (150 mV) proportional to the variation in the current time. Measurement of the current is obtained by integrating the signal;
- just two coils cover the range of rated currents from 0 to 3200 A;
- the winding can remain open even with the switchgear in service.

ABB KEVCD type combined voltage-current sensors.

Voltage sensor

The voltage sensor consists of a resistive divider through which the signal is taken up. This sensor, too, is of the unsaturable and linear type over the whole measurement range. The output signal is a voltage directly proportional to the primary voltage. The resistive element consists of a bar made of ceramic material.
The voltages sensors are used for taking measurements and for supplying the protections with power simultaneously.

Main characteristics of the voltage sensors

– linear response over the whole measurement range;
– no saturation phenomenon;
– no ferroresonance phenomenon;
– a single instrument for protections and measurements;
– high class of precision;
– high degree of immunity to electromagnetic interferences;
– the output signal is a voltage directly proportional to the primary voltage;
– the division ratio is 10000/1;
– a single divider covers the range from 0 to 24 kV rated voltage.

6 PROTECTION AGAINST INTERNAL ARCS

In a piece of metal-clad apparatus it is extremely unlikely for an arc to occur since it has been designed and built to prevent these faults.
In the arc proof version, the UniSafe switchgear constructed by ABB guarantees maximum personnel safety.
It can, in fact, resist the overpressures caused by the arc and is fitted with exhaust ducts to convey the gases generated away and therefore to prevent damage to operators and apparatus.

The arc-proofing test is carried out to check that the compartment doors remain closed, that no component detaches itself violently from the switchgear, even when subjected to very high pressures, that no flames or incandescent gases come out, thereby preserving the physical safety of the personnel operating near the switchgear, that no holes are made in the freely accessible external parts of the housing and, finally, that all the connections to the earthing circuit remain efficient, guaranteeing safety of the personnel who might have to access the switchgear after the fault.

The IEC 62271-200 Standard prescribes the methods for carrying out the test and the criteria the switchgear must answer to. The parameters indicated by the standard are as follows:

1 the switchgear doors must remain closed and the covering panels must never open up
2 any part of the switchgear which may be hazardous for personnel must never detach itself
3 there must be no piercing on the external housing of the switchgear in the parts accessible to personnel
4 the vertical and horizontal fabric indicators placed outside the switchgear must not catch fire
5 all the switchgear earthing connections must remain efficient.

If an IAC classification results from the tests, the metal-clad switchgear will be designated as follows:

– General aspects: IAC classification (initials of Internal Arc Classified, i.e. classified as arc proof)
– Accessibility: A, B or C: switchgear only accessible to authorised personnel (A), to everyone (B), not accessible to due the installation (C)
– Test values: test current in kilo amperes (kA) and time in seconds (s).

The UniSafe switchgear built by ABB is classified IAC AFLR.
Some fundamental aspects must be taken into consideration during installation of the switchgear:

- level of the fault current (16...50kA)
- fault duration (0.1...1s)
- exit paths for the hot and toxic gases given off by combustion of materials
- dimensions of the room, with particular attention to the height.

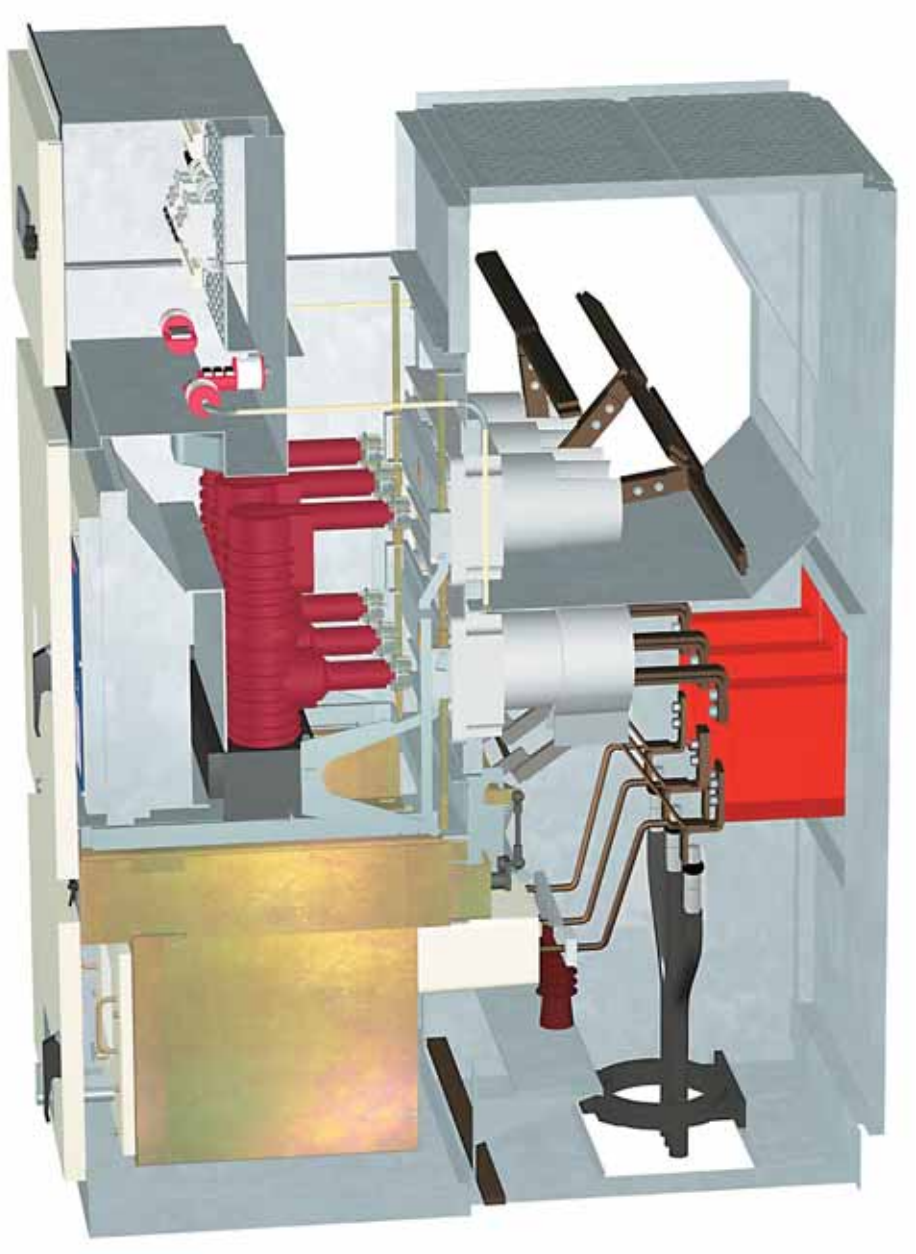
Preparation of the fabric indicators for the arc proof test.

Filming the test with an infrared camera.

Fast Recovery

UniSafe switchboards can be equipped with a specific protection system called Fast Recovery. This system is based on pressure sensors suitably located in the switchgear and directly connected to the shunt opening releases. The sensors detect the rising pressure front which develops during the first moments on formation of the arc and react promptly to open the circuit-breaker.
Thanks to the Fast Recovery System, there is selective exclusion of the part involved in the fault in less than 100 ms (including the circuit-breaker opening time).
A rapid elimination of the fault along with the metal segregation between compartments and the use of materials with a high self-extinguishing capacity reduces any possible damage due to the event to a minimum.

Fast Recovery pressure sensor.

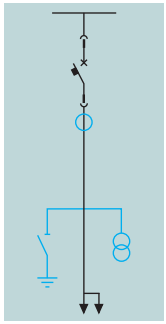


Section of the unit with Fast Recovery system pressure switches and ducting.

7 TYPICAL UNITS

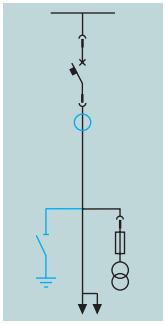
Options
Height
Height with gas duct
Depth

IF - Cable entry from below



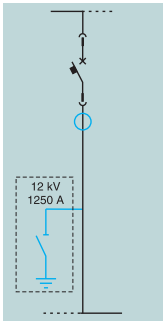
A1
A2
B1

IFM - Cable entry from below



A1
A2
B1

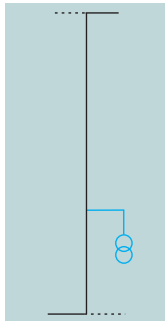
BT



A1
A2
B1

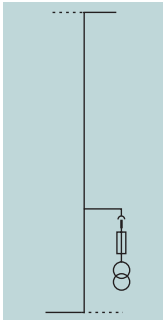
Options
Height
Height with gas duct
Depth

R



A1
A2
B1

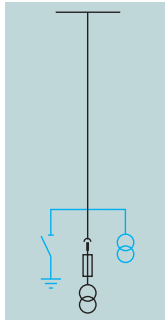
RM



A1
A2
B1

Options
Height
Height with gas duct
Depth

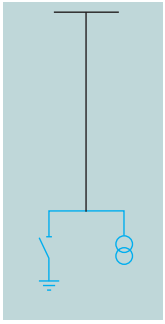
M



A1
A2
B1

M

L= 600 mm



A1
A2
B1

Rated voltage	A1	A2	B1
12 - 17.5 kV	2160 mm	2495 mm	1550 mm
24 kV	2160 mm	2600 mm	1900 mm

Type of unit and apparatus which can be installed

12 kV - 17.5 kV		Unit width									
		600 mm		750 mm				1000 mm			
HD4		630 A	1250 A	630 A	1250 A	1600 A	2000 A	2500 A	3150 A	3600 A	4000 A
VD4		630 A	1250 A	630 A	1250 A	1600 A	2000 A	2500 A	3150 A	3600 A	4000 A
V-Contact (1)		400 A									
IF	Incoming/outgoing	■ ■ ■	■ ■	■ ■	■ ■	■ ■	■ ■	■ ■	■ ■	■ ■	■ ■
IFM	Incoming/outgoing with measurements			■ ■	■ ■	■ ■	■ ■	■ ■	■ ■	■ ■	■ ■
BT	Bus-tie		■ ■		■ ■	■ ■	■ ■	■ ■	■ ■	■ ■	■ ■
R	Riser		■ (1)		■	■	■		■	■	■
RM	Riser with measurements				■	■	■		■	■	■
M	Measurements	■ (1)		■							

(1) Only 12 kV.

24 kV		Unit width				
		750 mm		1000 mm		
HD4		630 A	1250 A	1600 A	2000 A	2500 A
VD4		630 A	1250 A	1600 A	2000 A	2500 A
IF	Incoming/outgoing	■ ■	■ ■	■ ■	■ ■	■ ■
IFM	Incoming/outgoing with measurements	■ ■	■ ■	■ ■	■ ■	■ ■
BT	Bus-tie		■ ■	■ ■	■ ■	■ ■
R	Riser		■	■	■	■
RM	Riser with measurements		■	■	■	■
M	Measurements	■				

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