BRUSH

TRUST. WELL EARNED.

POWERBOND™

POWERING WORLDWIDE DC RAIL NETWORKS

AWARD WINNING MAGNETIC ACTUATOR TECHNOLOGY AT THE HEART OF GLOBAL RAILWAYS

Key benefits

- Low cost of ownership
- Proven design
- Customised solutions
- Award winning magnetic actuator technology

brush.eu

Description

PowerBond™ DC Switchgear is new range of DC switchgear products intended for transit applications. Line (Track Feeder) Switchgear includes a Busbar Selector which permits the contact line to be connected to a positive or a negative busbar via the circuit breaker.

The contact line can therefore be bonded to a safe potential using the same switchgear panel as is normally used to energise it. All current making and breaking is performed by the Circuit Breaker.

All maintainable elements are included on the withdrawable circuit breaker truck, including the motorised busbar selector and the current/voltage transducers.

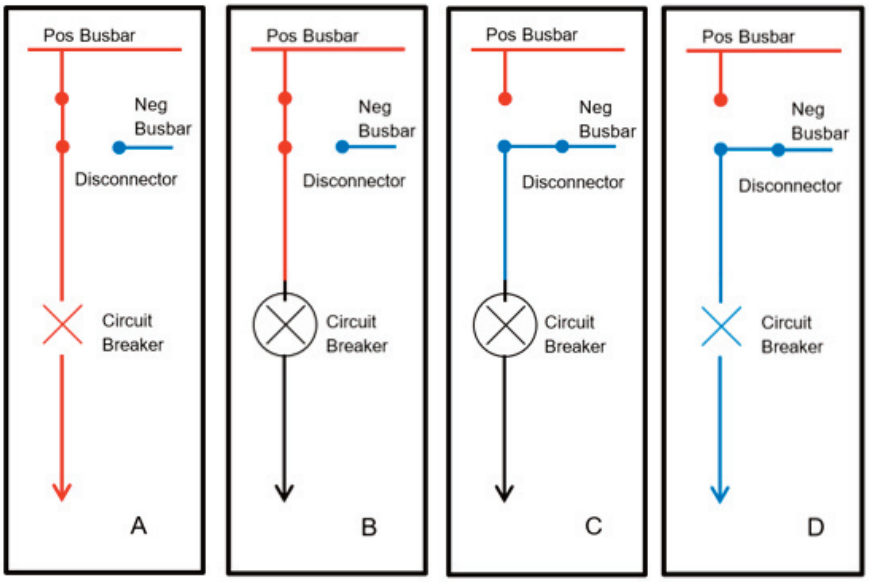


Figure	Busbar Selector	Circuit Breaker	Description
A	Positive	Closed	PowerBond™ is providing power to the contact line. The unit acts as a Line (Track Feeder) Circuit Breaker, with all protection (e.g. Impedance, Undervoltage & Direct Acting) operational
B	Positive	Open	PowerBond™ is not supplying power to the contact line but is ready to do so. The Busbar Selector may be moved to the Negative position.
C	Negative	Open	PowerBond™ is not bonding the contact line to negative but is ready to do so. The Busbar Selector may be moved to the Positive position. Optional track alive CB closing inhibit available
D	Negative	Closed	PowerBond™ is connecting the contact line to the system negative and is acting as an NSCD. Feeder protection, including the Direct Acting Trip, is disabled in this position.

1. Alternatively, this busbar may be connected to Earth.

Features

PowerBond™ includes the below features:

1. Intended for 750V dc and 1500V traction power systems, both overhead line and conductor (3rd and 4th) rail.
2. The High-Speed DC Circuit Breaker is based on the BRUSH Switchgear 'NDC' circuit breaker, which has many thousands of units in service worldwide.
3. The Circuit Breaker features a Patented Design Magnetic Actuator mechanism which offers reduced maintenance and improved performance against other operating mechanism types.
4. Line (Track Feeder) and Rectifier Circuit Breakers are fitted with a Uni-directional Direct Acting Trip.
5. All current making and breaking is carried out by the circuit breaker; the busbar selector is an off-load device which is electrically interlocked with the circuit breaker.
6. Protection, including the Direct Acting Trip mechanism, is disabled when the Negative Busbar is selected.
7. The panel design is suitable for rear and bottom entry with optional front cabling access. Versions for top entry main cables are also available.
8. Interlocking between the Circuit Breaker Truck and the panel prevents access to live parts. Electrical interlocking eliminates the need for external Interlock or Inhibit boxes.
9. Transducers (with the associated transducer fuses) are mounted on the withdrawable truck, for the safety of maintenance, test and commissioning teams.
10. Fully customisable control and protection scheme, which is compatible with a wide range of protection relays including the BRUSH Switchgear Mitre+.

Circuit Breaker Configurations

The following circuit breaker configurations will be available:

Type	Busbar Selector Fitted?	Direct Acting Trip Fitted?
4kA Line (Feeder)	Yes	Yes (4-16kA standard)
6kA Rectifier	No	Yes (3kA standard)
8kA Rectifier	No	Yes (4kA standard)
6kA Interconnector	No	Optional
8kA Interconnector	No	Optional

2. 8000A Rectifier circuit breakers will be available in the future
3. 8000A Interconnector circuit breakers will be available in the future

POWERBOND™

Ratings

Ratings to EN 50123-1/2/6 and IEC 61992-1/2/6	Symbol	900 V Version	1800 V Version
Nominal Voltage	U_n	750V	1500V
Rated voltage	U_{Ne}	900V	1800V
Rated insulation voltage	U_{Nm}	1800V	3000V
Rated impulse withstand voltage	U_{Ni}	18kV	18kV
Power Frequency Withstand	U_a	6.9kA / 8.3kV	6.9kA / 8.3kV
Overvoltage	OV	4	3
Pollution degree	PD	4	4
Rated Auxiliary Voltage		48V, 50V, 110V or 125V dc	
Circuit Breaker Rated Service Current	I_{Ne}	4000A (L) 6000A (R) 8000A (R; I)	4000A (L) 6000A (R)
Busbar Selector Rated Service Current	I_{Ne}	4000A (+ve) 500A (-ve)	4000A (+ve) 500A (-ve)
Positive Busbar Rated Service Current	I_{Ne}	6000A or 8000A	
Negative Busbar rated Service Current	I_{Ne}	500A	
Rated Short Circuit Current	I_{Nss}	125kA / 180kAp	100kA / 142kAp
Rated Short Time Withstand (Circuit Breaker)	I_{Ncw}	63kA / 90kAp for 250ms	
Rated Short Time Withstand (Positive Busbar)	I_{Ncw}	125kA / 180kAp for 250ms	
Rated Short Time Withstand (Negative Busbar)	I_{Ncw}	70kA / 100kAp for 250ms	
Rated Short Time Withstand (Earth Bar)	I_{Ncwe}	10kA / 14.2kAp for 1s	
Rated Track Time Constant	Nc	100ms	63ms
Duty – Line (Feeder) Breakers		f, e, d, l – duty cycle 1	
Duty – Rectifier Breakers		r, s, lr	
Duty – Interconnectors		ff, fr, lr	
Critical current		50A Bi-Directional	
Service life		40 years	
Mechanical endurance – Circuit Breaker		20 000	
Mechanical endurance – Busbar Selector		10 000	

4. 1800V versions will be available in the future. Data subject to confirmation following type testing.

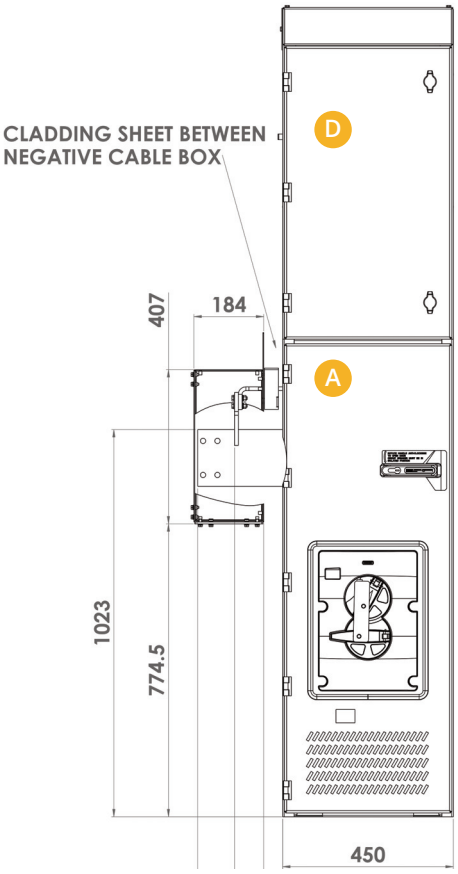
TRUST. WELL EARNED.

Dimensions

Dimensions (per panel) as
shown on diagram to the right:
450mm Wide; 1520 Deep; 2139 High.

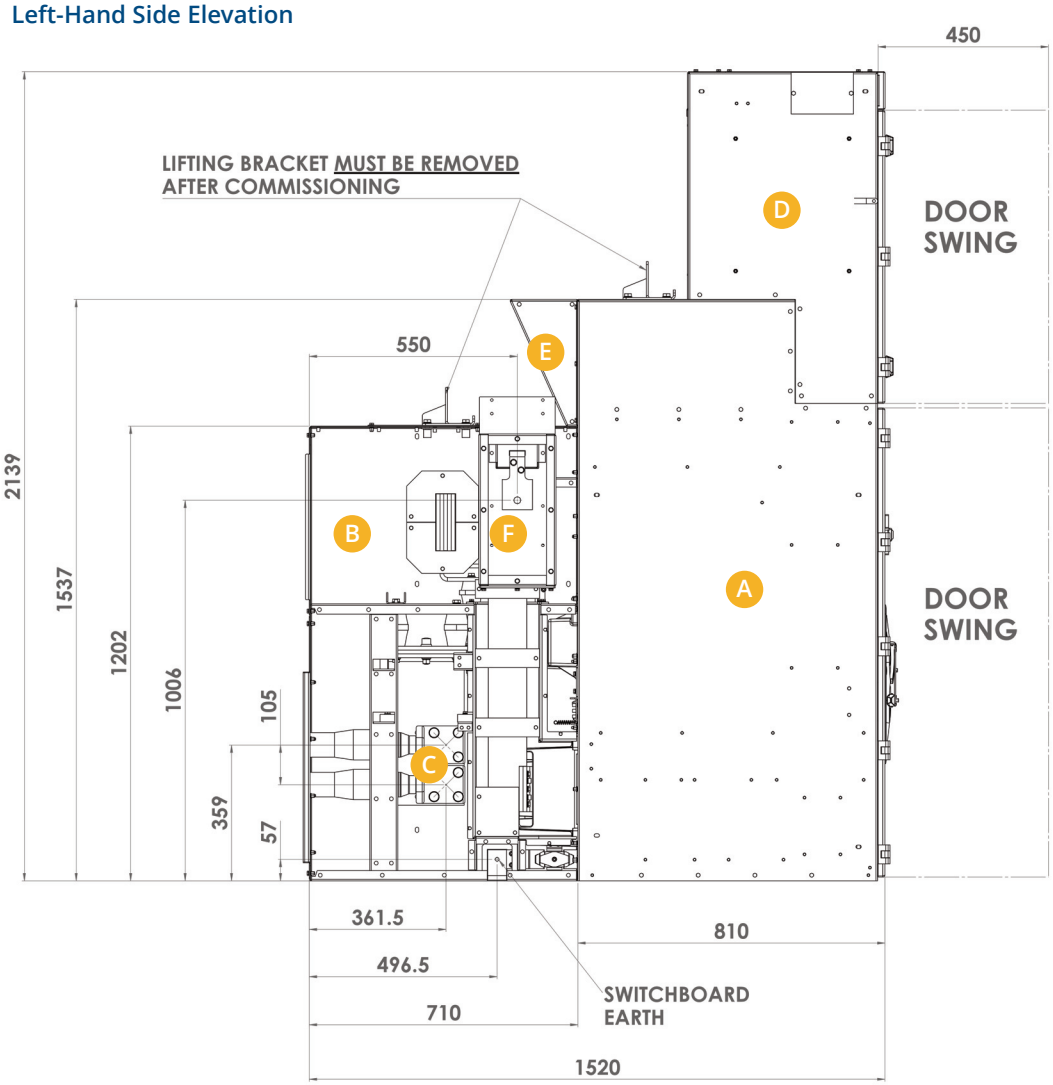
Key:

- A Circuit Breaker Compartment
- B Busbar Compartment (Positive)
- C Cable Compartment
- D Low Voltage Compartment
- E Vent (allow 600mm free space above vent)
- F Busbar Compartment (Negative)



Front Elevation

Left-Hand Side Elevation



Key Substation Design Requirements

- Space required in front of switchboard to allow CB Truck withdrawal: 1200mm
- Space required to the rear of the switchboard to allow rear access for cabling: 600mm
- Space required to the rear of the switchboard when cable access is via the front of the panel (bottom or rear main cables only): 100mm (with frame leakage) or 50mm (no frame leakage)
- Space required to the left of the switchgear: 600mm (to allow doors to open)
- Space required to the right of the switchgear: 100mm
- The finished floor for the switchgear should be ±3mm over a common datum line over any 2500mm length. The floor should be flat and level for 1200mm in front of the switchboard.

Weights

Type	Panel Weight (less breaker)	Breaker Weight
4kA Line (Feeder)	360kg	295kg
6kA Rectifier	390kg	290kg
8kA Rectifier	400kg (TBC)	300kg (TBC)
6kA Interconnector	390kg (TBC)	290kg (TBC)
8kA Interconnector	400kg (TBC)	300kg (TBC)
Frame Leakage	300kg	N/A

Frame Leakage Panel

Optional switchboard frame leakage panel (with the same dimensions as a circuit breaker panel). This may be provided with or without cable boxes for the Positive and Negative cables.

Optional wall-mounted frame leakage panel (details on request).

Frame leakage insulated flooring thickness: 3mm (installed on top of finished floor level).

Heat Losses

Type	100% Load, Continuous	Typical Load
4kA Line (Feeder)	650W	350W
6kA Rectifier	750W	600W
8kA Rectifier	To be confirmed	To be confirmed
8kA Interconnector	To be confirmed	To be confirmed

5. Actual heat losses are subject to substation loading and should be calculated for each substation to ensure the correct design of ventilation systems or cooling plant.

Auxiliary Power

Switching Loads for 48V dc version:

Operation	Current and duration @ 48V dc
Circuit Breaker Close	80A peak, 250ms nominal
Circuit Breaker Open (Reset)	25A peak, 200ms nominal
Capacitor Charge (following a trip command)	<6A, 6 seconds nominal
Busbar Selector Position Change	Running: 3.5A, 3.5 seconds nominal Peak, while connecting: 8A, <0.5 second nominal

Standing loads (Estimated) @ 48V dc: Line (Feeder) – 1.0A; Rectifier – 0.5A; Interconnector – 0.5A; Frame Leakage – 0.25A. Standing loads subject to control and protection scheme and will vary.

Anti-condensation heaters (optional): 70W @ 110V or 230V ac.

Cable Entry Options

Main Cable Entry options:

- Rear
- Bottom
- Top (requires the addition of an 450mm deep adaptor chamber to the rear).

Up to 4 x 1000 mm2 cables can be accommodated in a Line (Feeder). Up to 8 x 1000mm2 cables can be accommodated in a Rectifier or Interconnector panel. Details of quantities for other cable sizes available on request.

100mm clearances or enhanced insulation is provided on the outgoing feeder panel circuit only.

Control cable entry from the top/rear of the Low Voltage Compartment.

BRUSH

TRUST. WELL EARNED.

POWERBOND™

BRUSH
Switchgear Division: Unit 3, Blackwood Business Park,
Newport Road, Blackwood, South Wales NP12 2XH United Kingdom

T: +44 (0) 1495 223 001
E: sales@brush.eu

September 2022