



# Step-up Transformer Substation (PV)

Catalogue  
2024

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## Function

Our step-up substation converts low-voltage AC power generated by the PV inverter into medium-voltage AC power and feeds it into the power grid.

The Brunstock Electric step-up substation integrates a ring main unit, transformer, low-voltage cabinet and auxiliary power supply into a steel container. This is a highly integrated power transformation and distribution solution for ground-based PV plants in medium-voltage grid-tied applications.

## Features

### Intelligent

- Detects the operating status of the ring main unit, transformer and low-voltage switchboard in real time
- Displays power parameters online, with accurate current and voltage detection
- Supports remote access to the running information of the complete step-up substation
- Enables remote control of the circuit breaker for the low-voltage switchboard and ring main unit.

### Prefabricated

- Internal equipment has been prefabricated and will be installed
- 20-foot container structure facilitates easy transportation and installation

### Reliable

- Solid and reliable structure design
- IP54 rating of medium-voltage/low-voltage rooms.

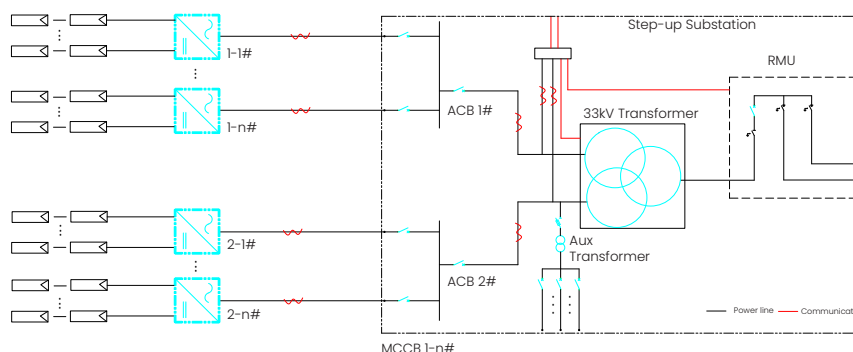
### Fast

- Fast deployment can be implemented
- Only low-voltage cables need to be routed in and medium-voltage cables need to be routed out onsite

## Application

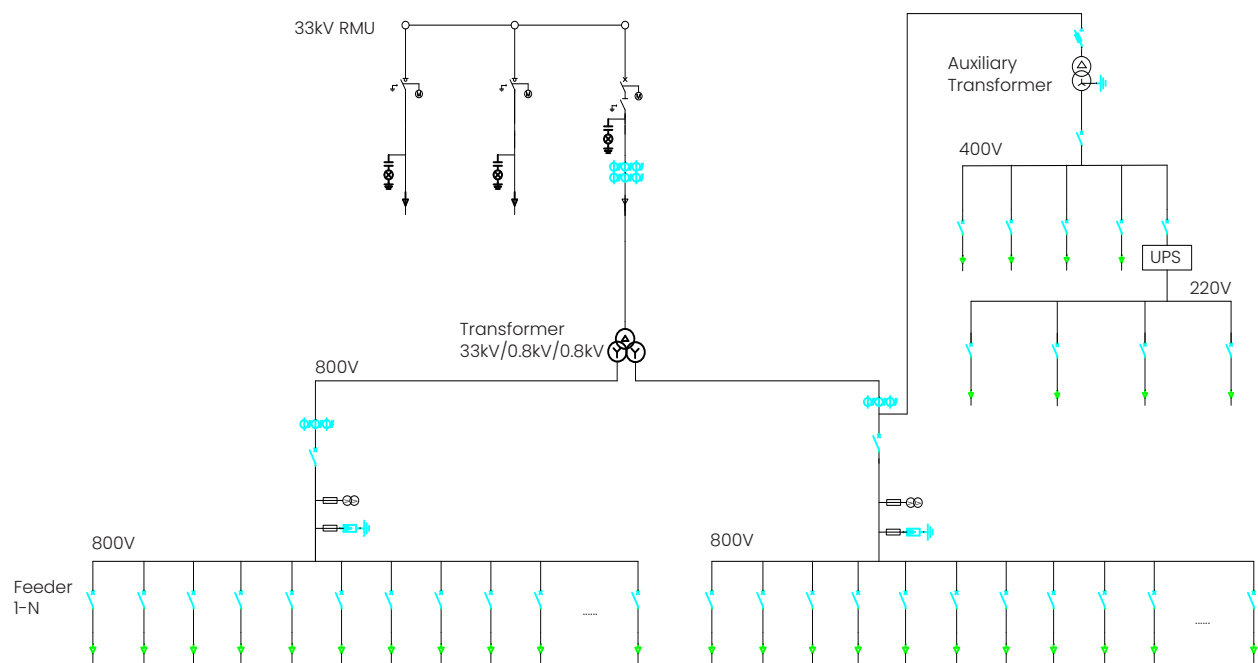
The step-up substation applies to grid-tied systems in large PV plants.

### Network application





Example for 9MVA step-up substation



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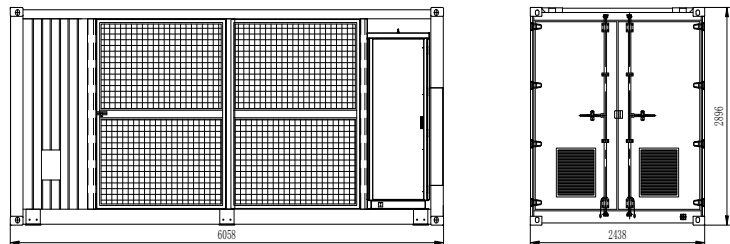
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## Appearance

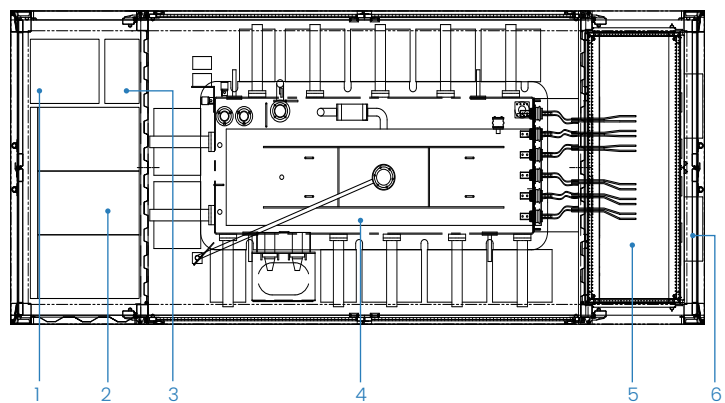


## Exterior dimensions



For ease of transportation, the substation has the same dimensions as a 20-foot container: 6,058mm wide x 2,896mm high x 2,438mm deep.

## Internal composition



- 1 Auxiliary transformer
- 2 MV switchgear RMU
- 3 UPS cabinet and communication box
- 4 Transformer
- 5 LV cabinet
- 6 Air conditioning

Type	3,000kVA	6,000kVA	9,000kVA
Transformer			
Transformer type	Oil Transformer		
Rated power	3,000 kVA @ 40°C <sup>1</sup>	6,000 kVA @ 40°C <sup>1</sup>	9,000 kVA @ 40°C <sup>1</sup>
Max. power	3,400 kVA @ 30°C	6,800 kVA @ 30°C	9,000 kVA @ 30°C
Vector group	Dyll	Dylllyll	Dylllyll
LV / MV voltage	0.8 kV / 20 – 35 kV	0.8kV/0.8 kV / 20 – 35 kV <sup>2</sup>	
Maximum input current at nominal voltage	2,500 A * 1	2,500 A * 2	4,000 A * 2
Frequency	50Hz		
Tapping on HV	0, ±2×2.5%		
Efficiency	≥99%		
Cooling type	ONAN (Oil Natural Air Natural)	ONAN (Oil Natural Air Natural)	ONAN (Oil Natural Air Natural)
Impedance	6.5% (±10%)	6.5% (±10%)	9.5% (±10%)
Oil type	Mineral oil (PCB free)		
Winding material	Al / Al		
Insulation class	A		
MV switchgear			
Insulation type	Dry air (SF6-free)		
Rate voltage	24–36 kV <sup>2</sup>		
Rate current	630 A		
Internal arcing fault	IAC AFLR 20kA/1s; 25kA/1s		
Qty of feeder	2–3 feeders		
MV surge arrester for VCB	Optional <sup>3</sup>		
LV panel			
ACB specification	2,500 A / 800 Vac / 3P, pcs	2,500 A / 800 Vac / 3P, 2 pcs	4,000 A / 800 Vac / 3P, 2 pcs
MCCB specification	250 A / 800 Vac / 3P, 1*17 pcs	250 A / 800 Vac / 3P, 2*17 pcs	320 A / 800 Vac / 3P, 2*15 pcs
Protection			
AC input protection	Circuit breaker		
Transformer protection	Oil-temperature, oil-level, oil-pressure		
Relay protection	50/5I, 50N/5IN		
LV overvoltage protection	AC Type II (optional: AC Type I + II)		
Anti-rodent protection	C5-Medium		
General data			
Dimensions (W*H*D)	6,058mm x 2,896mm x 2,438mm		
Approximate weight	≤ 5 T	≤ 22 T	≤ 28 T
Operating temperature range	-25°C ~ 60°C <sup>4</sup>		
Auxiliary power supply	5 kVA / 400 V (optional: max. 40 kVA)		
2kVA UPS	Optional <sup>3</sup>		
Degree of protection	IP54		
Allowable relative humidity range (non-condensing)	0 – 95 %		
Operating altitude	1,000 <sup>5</sup> m (standard) / > 1,000 m (optional)		
Communication	RS485, Ethernet, Optical fiber		
Compliance	IEC 60076, IEC 62271-200, IEC 62271-202, IEC 61439-1, EN 50588-1		

1. For more details on the AC power, please refer to the de-rating curve.

2. Rated output voltage from 20 kV to 36 kV, more available upon request.

3. Extra features are available that the standard product doesn't contain, more options upon request.

4. When ambient temperature ≥55°C, an extended roof will need to be installed onto the substation on site by the customer.

5. For higher operating altitude, please consult with Brunstock.



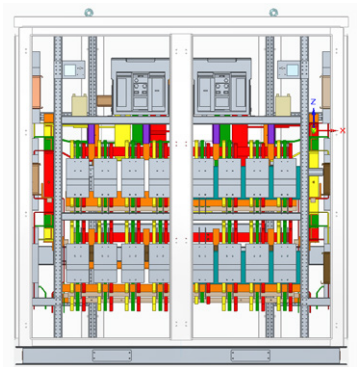
A transformer substation container consists of three parts: low-voltage room, transformer room, and medium-voltage room.

Low-voltage room

The LV cabinet is located at the LV room inside the step-up substation. It is used to converge and transmit low voltage from the inverter to the step-up transformer and feed it into the MV grid.

The LV cabinet consists of a LV Air Circuit Breaker (ACB), a Moulded Case Circuit Breaker (MCCB) and other electric components.

Taking the 9,000kVA as an example, the figure below shows the internal components of the LV cabinet.



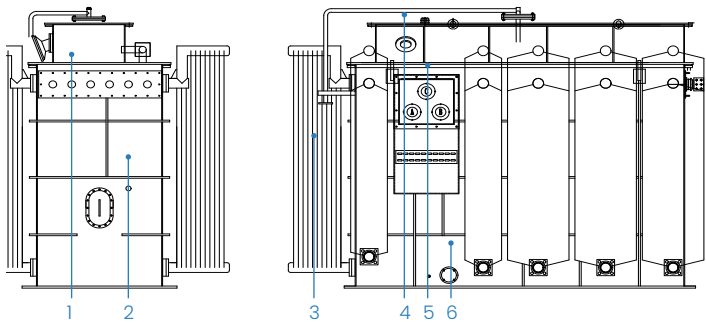
Low-voltage switchgear		
Type		Description
Standard compliance		IEC 61439
Rated voltage	V	AC800
Insulation voltage	V	AC1,000
Ingress protection	IP	IP65
Rated short circuit withstand current Icw	kA	50/1
Impulse withstand voltage Uimp	kV	12 for incoming / 8 for feeders
Main switch-ACB		Fixed, manual/electric operation, Ui=1,250V, Uimp=12kV, Ue=800V, In=4,000A, Icu=75kA at 800Vac, Icw=75kA-1s, TMD
Branch-MCCB		Fixed, manual operation, Ui=1,000V, Uimp=8kV, Ue=800V, In=320A, Icu=50kA at 800Vac, TMD
Branch-MCCB		Fixed, manual operation, Ui=1,000V, Uimp=8kV, Ue=800V, In=250A, Icu=50kA at 800Vac, TMD
Input AC cable terminal		Screw connector, Cu or Al, max 300mm2
Cable entry		Based on specific design
SPD		Uc=1,500V
Power meter		Current, voltage, active and reactive power, etc
Air conditioner	Unit	2
Dimension	mm	L2,240 x D1,040 x H2,400
Ingress protection	IP	IP55

Transformer room



The transformer room mainly includes a transformer inside, which is used to convert the low-voltage AC power into medium-voltage AC power.

The transformer integrates accessories such as a pressure relief valve, tap changer, oil level indicator, pressure gauge, oil temperature indicator, oil filling valve and oil drain valve.



- 1 LV bushing
- 2 Tap changer
- 3 Heat sink
- 4 Oil level meter
- 5 HV bushing
- 6 Oil drain valve

The structure of 9,000kVA is shown in Fig. The oil-cooled transformer adopts natural heat dissipation, and the top is not covered.

Step-up transformer			
Items		9,000/33, 3 windings, oil immersed	
Rated output		kVA	9,000
Vector group			Dy11y11
Type of cooling			ONAN
Rated voltage	HV	kV	33
	LV	kV	0.8
	Voltage variation		±10%
Rated current	HV	A	154
	LV1	A	3,248
	LV2	A	3,248
Number of phases			3
Rated frequency		Hz	50
Frequency variation		%	±5
Conductor materials	HV		Aluminum
	LV		Aluminum
Tap changer	LV		Off circuit
	HV		±2x2.5%

Note: For more transformrer ratings please consult with your Brunstock representative

Insulation level	HV	kV	LI 170/AC 70
	LV	kV	AC 5
Dimension		mm	W3,600 x D2,200 x H2,600
Weight	Core and winding	kg	8,700
	Oil	kg	4,000
	Others	kg	4,935
	Total	kg	17,635

## Medium-voltage room



The medium-voltage room contains a Brunstock gas insulated secondary ring main unit.

The circuit breaker offers transformer protection mainly through the relay protection device. When the transformer is overloaded or short-circuited, the circuit breaker will disconnect. When the transformer experiences an over-temperature fault, heavy gas fault, or oil over pressure fault, the circuit breaker trips and the system is quickly protected.

The medium-voltage room also contains a communication box and a power distribution cabinet inside.

### Medium-voltage switchgear

Type		RMU	
Rated voltage		kV	40.5
Rated frequency		Hz	50
1 min power frequency withstand voltage (RMS, phase to phase, to earth/across isolating distance)		kV	95/118
Lightning impulse withstand voltage (RMS, phase to phase, to earth/across isolating distance)		kV	185/215
Rated busbar current		A	630/1,250
Rated short-circuit breaking current		kA	20/25/31.5
Rated short-time withstand current/duration	Load switch	kA/s	20/4; 25/3
	Circuit breaker	kA/s	25/3; 31.5/4
Protection degree of gas-filled compartment		IP	67
Protection degree of switchgear		IP	4X
Panel dimension without top box (W x D x H)		mm	450/500x980/1,000x1,900
Functional panel weight		kg	650~700
Extension			Top ( Lateral optional)
Internal arc classification		kA/s	C: AFLR 25/1; 20/1 V: AFLR 25/1; 31.5/1

## Auxiliary power supply

Auxiliary power supply consists of auxiliary transformer, auxiliary power supply box and UPS. Both the external and internal components of the cabinet can be supplied by Brunstock.



- 1 Auxiliary power supply box
- 2 UPS cabinet and communication box
- 3 Auxiliary transformer

### Auxiliary power supply

#### Auxiliary transformer

Transformer type	KVA	15 (5-15, optional >15)
Rated voltage	V	800/400
Connection symbol		Dyn11
Auxiliary transformer enclosure dimension	mm	W400 x D400 x H500
Auxiliary transformer location		MV compartment, floor mounted

#### Power supply box

Incoming MCB	Pcs	1, 63/C32A,3P, OF
Feeder MCB	Pcs	5, 63/C16/10/6A,2P, 400V
Feeder MCB	Pcs	4, 63/C32/6A,2P, 220V
Dimension	mm	W600 x D180 x H800

#### UPS

UPS	Set	1 x 2kVA/ 2h, or on request
Battery	Pcs	6 x 12V/7Ah, or on request

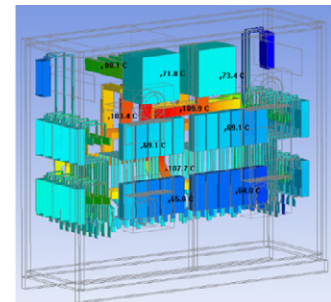
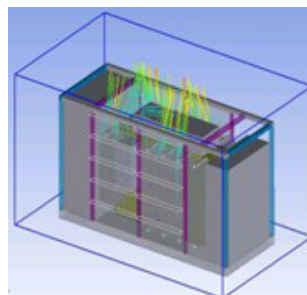
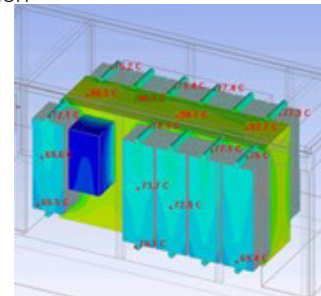
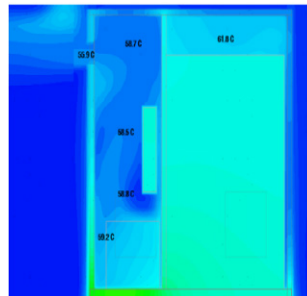
## Thermal design

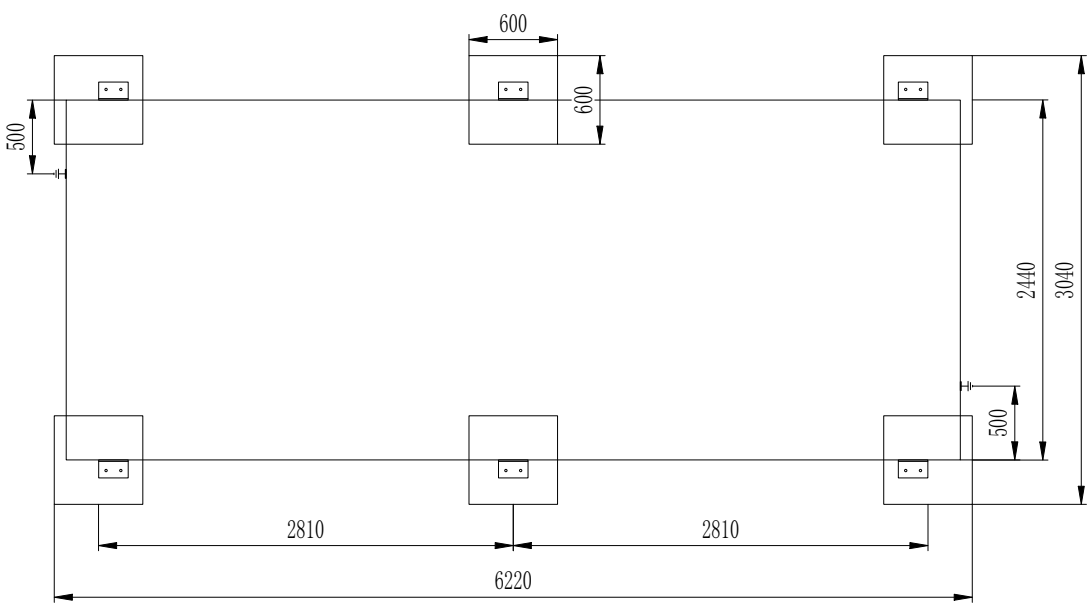
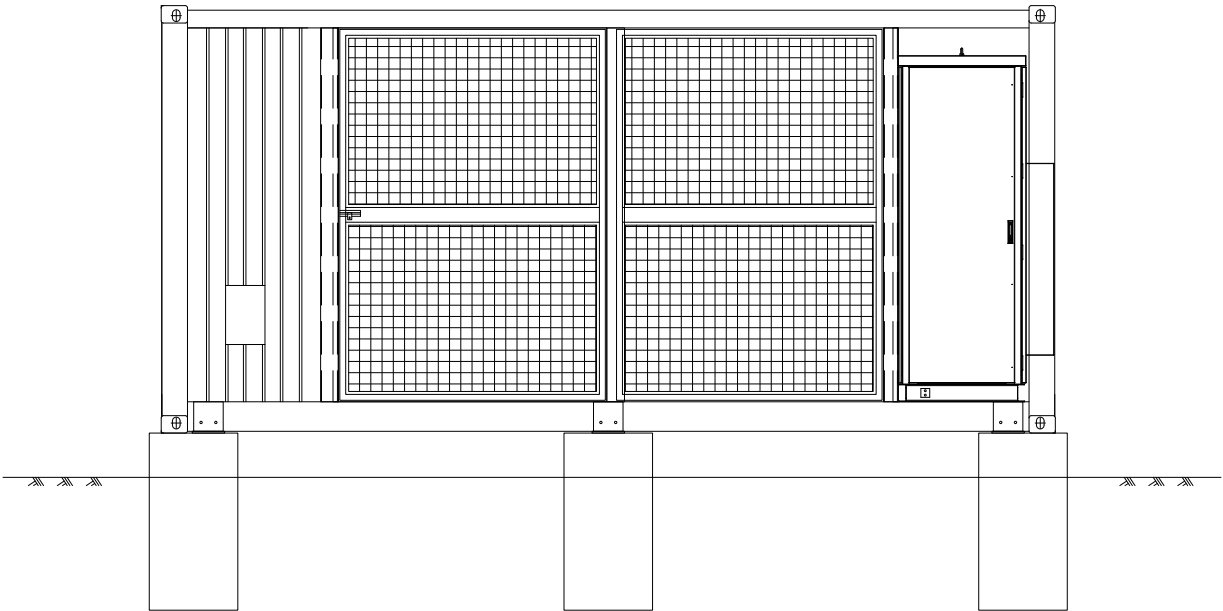
Considering the different working conditions and requirements for each compartment and component, Brunstock's step-up substation adopts different cooling methods for different compartments:

- The ingress protection level of the LV room/cabinet is high, so air conditioning is used to take away the LV room/cabinet indoor heat
- The MV transformer adopts ONAN mode
- The MV switchgear and the communication and power distribution cabinet adopt the cooling method of natural cooling via vents, air intake from the bottom and air extraction by the fan above.

Our science-based cooling structure design ensures cooling efficiency and effectively extends the service life of internal components and the entire container.

Flow field analysis of step-up substation





This figure is for reference only



