AVL
REACH LIMITED

RECTIFIERS

CITY ELECTRIC TRANSPORT ■
RAILWAYS ■ METRO

BUILDING FUTURE **TOGETHER**!

Rectifiers for Traction Substations

AVL Reach Limited offers several types of rectifiers depending on required current value and rectification circuitry (12-pulse and 6-pulse bridge rectifier circuit, according to EN 50238:2003, Table 4, connections 8,9,12).

Rectifiers developed utilising only eco-friendly materials minimizing any environmental impact during production cycle. Well planned life cycle allows environmentally safe operation, maintenance and scrapping of equipment at the end of its lifetime.

We provide a broad range of services and maintenance support during whole life cycle of the equipment starting from design and installation to decommissioning, scrapping and recycling.

We support rectifiers during its whole lifetime with following services:

- personnel safe operation and maintenance training;
- warranty and post-warranty maintenance;
- spare parts supply.

Application Area

Rectifiers can be supplied for the following range of output voltages:

Voltage class	600 V	750 V	825 V	1500 V	1650 V	3000 V	3300 V
Tramway	■	■	■	■			
Trolleybus	■	■					
Light Rail	■	■	■	■			
Underground		■	■	■			
Railways				■	■	■	■

Rectifier Configuration and Main Features

AVL Reach rectifiers are distinguished by advanced technological solutions applied to both design and diagnostics. Each rectifier equipped with self-diagnostic and control system providing best technological solution for protection, diagnostics and control. Integral software constantly monitors rectifier performance and helps to optimise system maintenance cycle to achieve cost-effective result.

Our preferable solution is based on rectifier with Resibloc® dry-type transformer. As per customer's request, transformers can also be cast resined, supplied with epoxy glass cloth, laminated, etc., to suit individual needs and requirements.

RESIBLOC® Dry Transformer:

- advanced protection, diagnostics and control system,
- innovative technological solutions,
- maintenance-free,
- long lifetime.

Rectifier:

- protection, diagnostics and control system,
- innovative schematic and technological solutions,
- minimum maintenance,
- long lifetime,
- low maintenance charges.

Compliance with International Standards

Rectifiers were successfully type-tested for compliance with International standards in test center IPH Institut (Berlin, Germany).

Rectifiers meet IEC 60146-1- 1:2009-06, EN 50328:2003 international standard requirements.

Rectifiers Main Technical Parameters

Name of parameter		Rectifier rated voltage		
		750 V, 825 V	1500 V, 1650 V	3000 V, 3300 V
Rated voltage	V	750*	1500, 1650	3000, 3300
Rated current	A	1600…4000*	2000…4000*	2000…4000*
Auxiliaries voltage	V	~110/220 (240)		
Rectification circuit		Bridge (6-pulse, 12-pulse)		
Number of connections (acc. to EN 50328)		8,9,12		
Cooling		Natural, Fan-forced		
Duty class (acc. to EN50328)		VI*		
Maximum ambient temperature	°C	40*		
Altitude	m	1000		
IP class (acc. to IEC60529)		IP21	IP21	IP20, IP21, IP43

* customised design values can deviate from stated above to meet specific customer requirements

Rectifier design can be customised for either indoor or outdoor configuration.

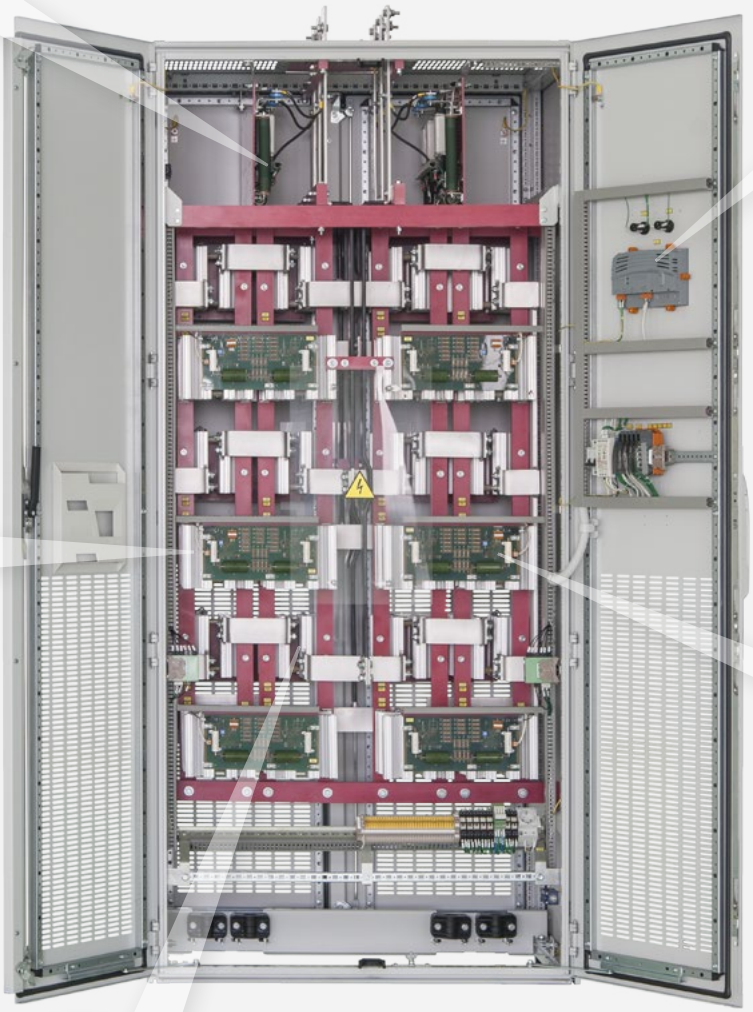
In case of outdoor installation control and diagnostic system is located separately and can be installed in a separate cubicle with an independent HVAC unit.

Rectifiers can be supplied either with natural air cooling or fan-forced ventilation. Fan-forced air cooling is a combination of natural convection cooling and additional ventilation forced by fans through the system when required. Rectifier operates with natural cooling under rated or lower loads. In case of risk of overheating under overload, protection system switches on fans and provides additional cooling for the diodes. Fans shut off automatically when fan-forced cooling is not required.

Rectifier Configuration and Main Features

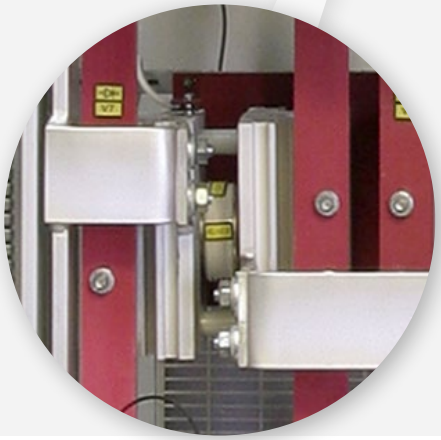
Switching surge protection

Power semiconductor devices are protected against internal and external switching surges. Diodes are protected against both internal and external switching surges by filtering circuits and varistors.



Power Diodes

Pill power diodes manufactured by VISHAY (formerly International Rectifier) are utilised in rectifiers. Two diodes in series are connected in each arm of rectifier.

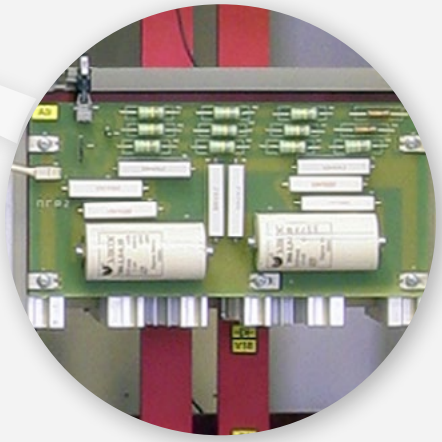


Contact Connections Stabilizing

Contact connections of rectifier are manufactured applying maintenance-free technology. Thus, there is no requirement for periodical checks and maintenance them during lifetime.

Diagnostics and Control System

The system is based on **industrial controller PP65** (with colored HMI panel) providing inline monitoring of each diode parameters during operation of the rectifier. It also provides events logging, visualisation of temperature distribution, voltage and other diode parameters, protection against rectifier and transformer overheating, protection against diodes breakdown, communication with SCADA system etc.



Galvanic isolation boards provide protection against overvoltage by in-built RC- circuits. In addition boards convert and supply data for diagnostic system.

Transformer

Dry-type transformers are frequently used in applications where contamination and fire risks are have to be eliminated. Modern RESIBLOC® dry-type transformers with a ratings starting from 630 kVA can be supplied in variety of high (HV) and low (LV) voltage options. RESIBLOC® transformer technology proved its essential reliability not only in oil gas and mining industries but also in the fields of power generation and distribution worldwide.

In addition to elimination of environmental hazards, RESIBLOC® transformers fully comply with stringent parameters in:

- fire safety;
- environmental compatibility;
- “cold” start with maximum load;
- high resistance to dynamic loads under overloads and short circuits;
- overvoltage withstand;
- low-maintenance;
- reliability in polluted, high humid and low temperature environment.

Transformers have original design of HV and LV winding made of wire and foil. Windings are shrouded with epoxy-impregnated fiberglass string.

Thanks to its glass-fibre content of approximately 80 %, RESIBLOC provides outstanding mechanical strength, meaning it is ideal for use in applications involving high mechanical stresses. For example, RESIBLOC is ideal for use in environments prone to earthquakes or applications with continual shock.

Other advantages of RESIBLOC technology relate to protection of the environment. Transformers can operate under condition of 100 % humidity, water vapour condensation, and chemical pollution. Transformers can be equipped with low noise radial fans. Additional Fan-forced cooling system can increase rated power up to 40 % or may allow reducing dimension and weigh parameters at the same power rate.

Diagnostics and Control System

Rectifiers are equipped with microprocessor control and diagnostics system. This system captures following information about condition of each diode and visualise it on HMI panel: «normal operation», «parameters de-rating», «failure», and diodes temperature.

Monitoring of each diode parameters is happening constantly during rectifier operation.

Diagnosis of these criteria can forecast potential failures and significantly improve maintenance cycle.

In case of diode parameters got deteriorated, the power diode can be replaced eliminating its imminent failure. In-built redundancy allows normal operation of the rectifier even if one diode is failed.

HMI is a modular type industrial controller PP65 with colour LCD screen produced by Bernecker&Rainer (Austria).

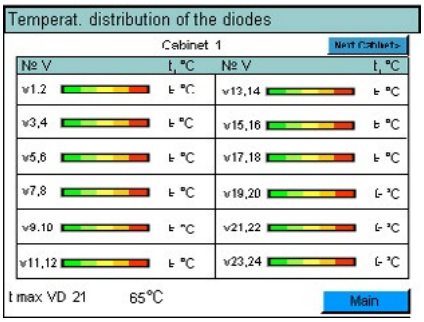
Industrial controller PP65 has significant processing power, high efficiency and compact size.

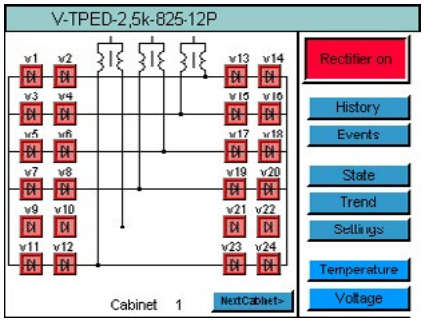
Information about state of the rectifier and its elements can be observed on visualisation panel or computer monitor through supplied software.

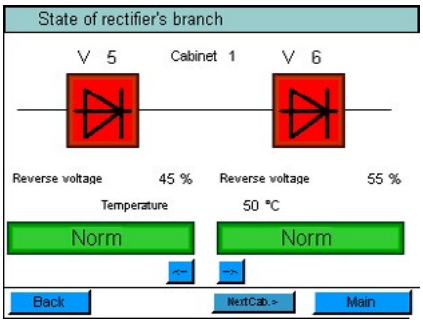
Mnemonic symbols of rectifier diodes, graphs of reverse voltage distribution between diodes and arms temperature are displayed on the panel along with the following data:

- rectifier single-line diagram;
- events log;
- diodes temperature;
- diodes temperature diagram;
- voltage distribution between two diodes in series;
- signals:
  - transformer overheating;
  - doors condition;
  - rectifier overheating;
  - diode parameters deterioration.

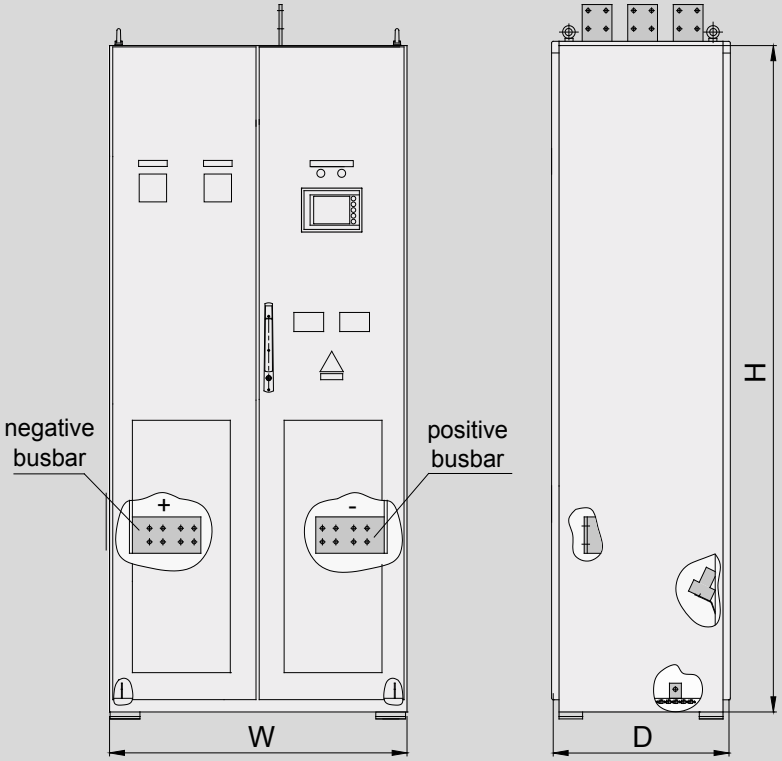
The rectifier diagnostic system constitutes and integral part of medium voltage switchgear protection device and SCADA system.



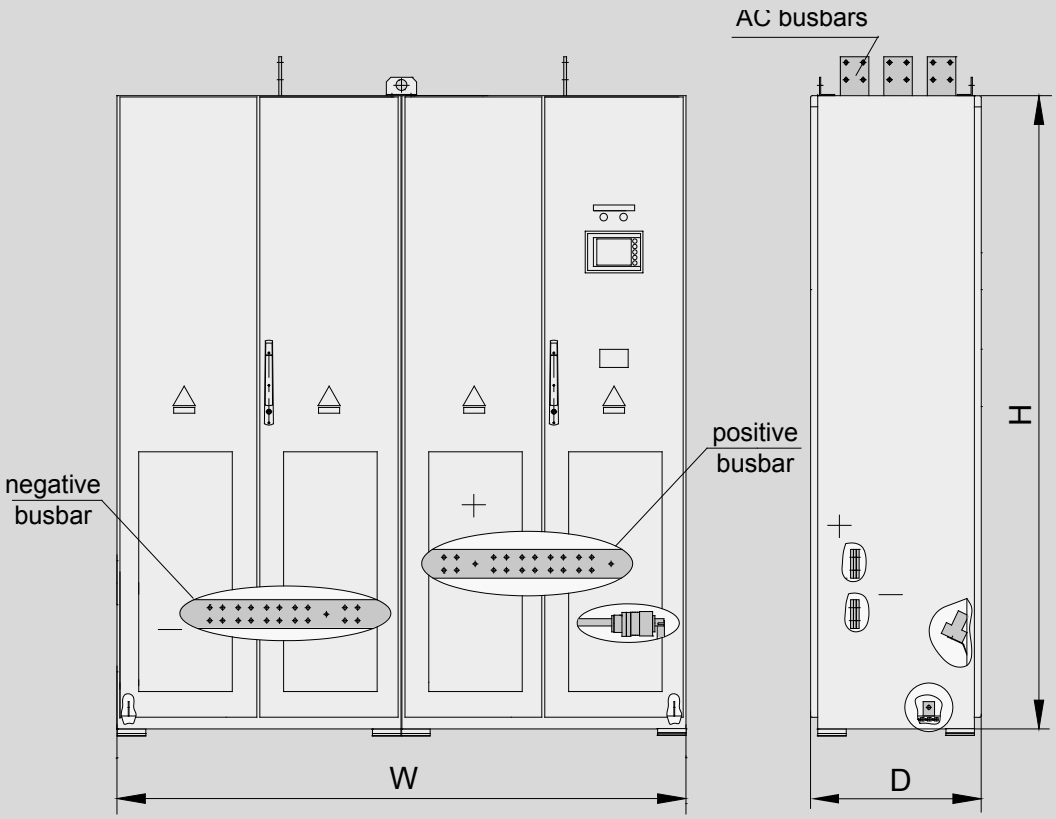




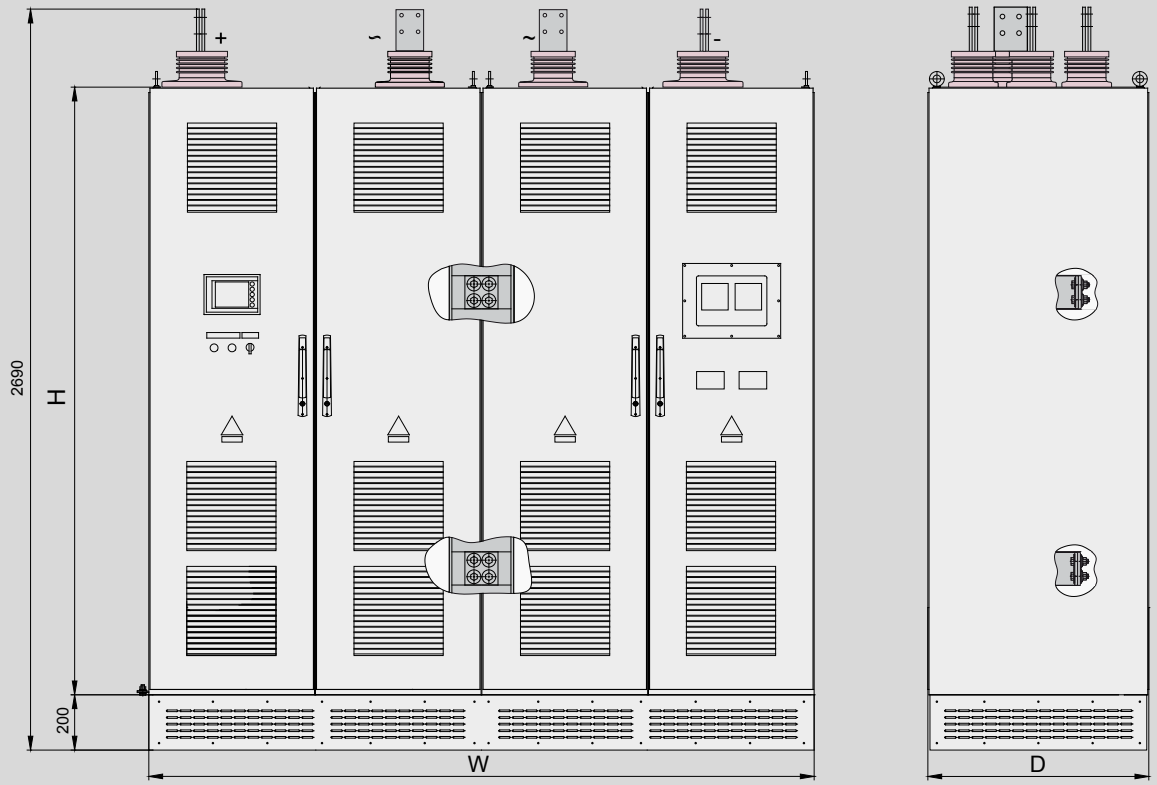
Rectifiers Overall Dimensions



Rectifier 750 V (825 V); 1600 A, with natural cooling,
VI duty class acc. EN 50328



Rectifier 750 V (825 V); 2500 A, with natural cooling,
Rectifier 750 V (825 V); 4000 A with forced cooling,
VI duty class acc. EN 50328

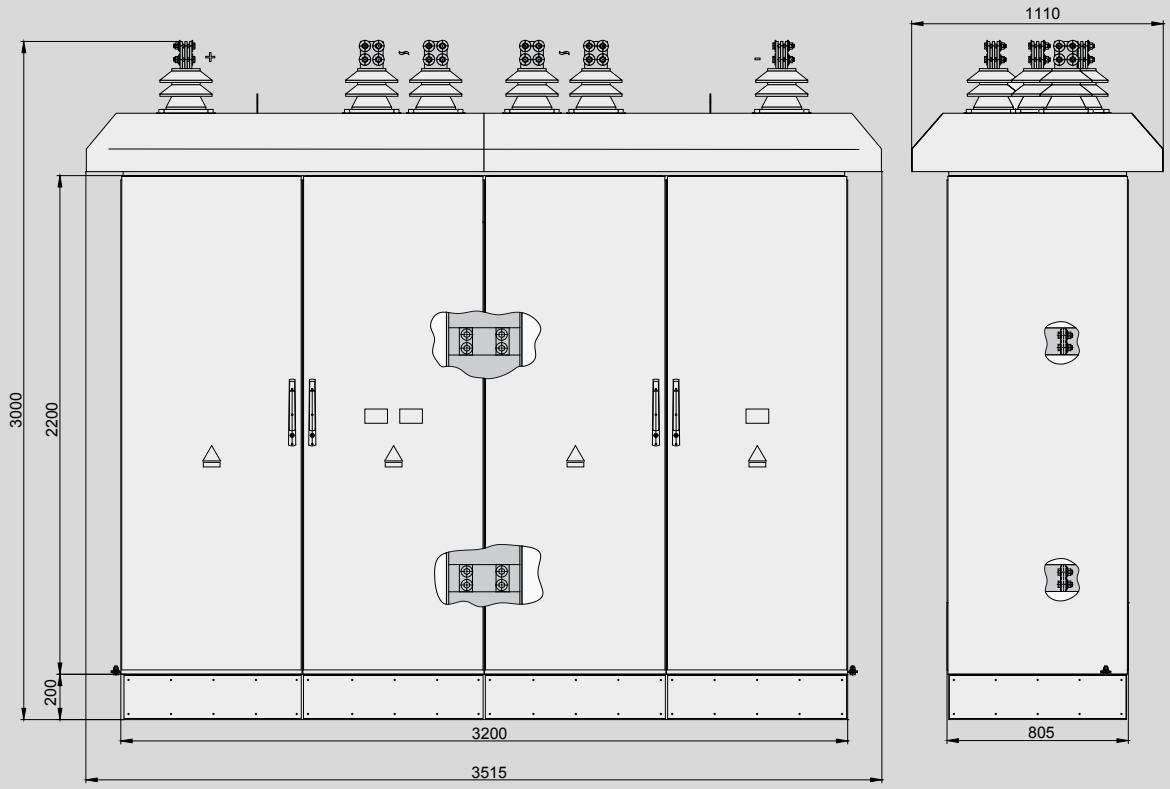


Rectifier 1650 V; 3150 A with natural cooling
Rectifier 1500 V (1650 V, 3300 V); 4000 A with forced cooling
VI duty class acc. EN 50328

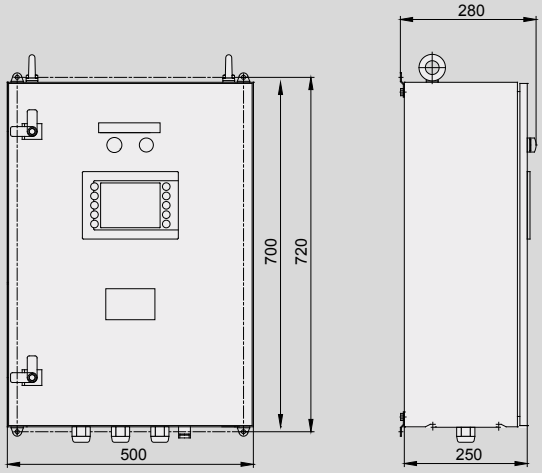
Rated output voltage, V	Rated output current, A	Rectification circuit acc. to EN 50328	Rectifier cooling type	W (Width), mm*	H (Height), mm*	D (Depth), mm*
750, 825	1600	8	natural	1000	2200	600
		9		1200		
	2500	8	natural	2000	2200	600
		9				
	4000	8	natural	4800	2200	800
		9	forced	2400	2200	800
1500, 1650	2000	8	natural	1400	2200	800
	3150	8	natural	2400	2200	800
		9	forced	2400	2200	800
	4000	8	natural	4800	2200	800
		9	forced	2400	2200	800
3000, 3300	2000	12	natural	2400	2200	800
	3150	12	natural	4800	2200	800
			forced	2400	2200	800
	4000	12	natural	4800	2200	800
			forced	2400	2200	800

* frame

Rectifiers Overall Dimensions

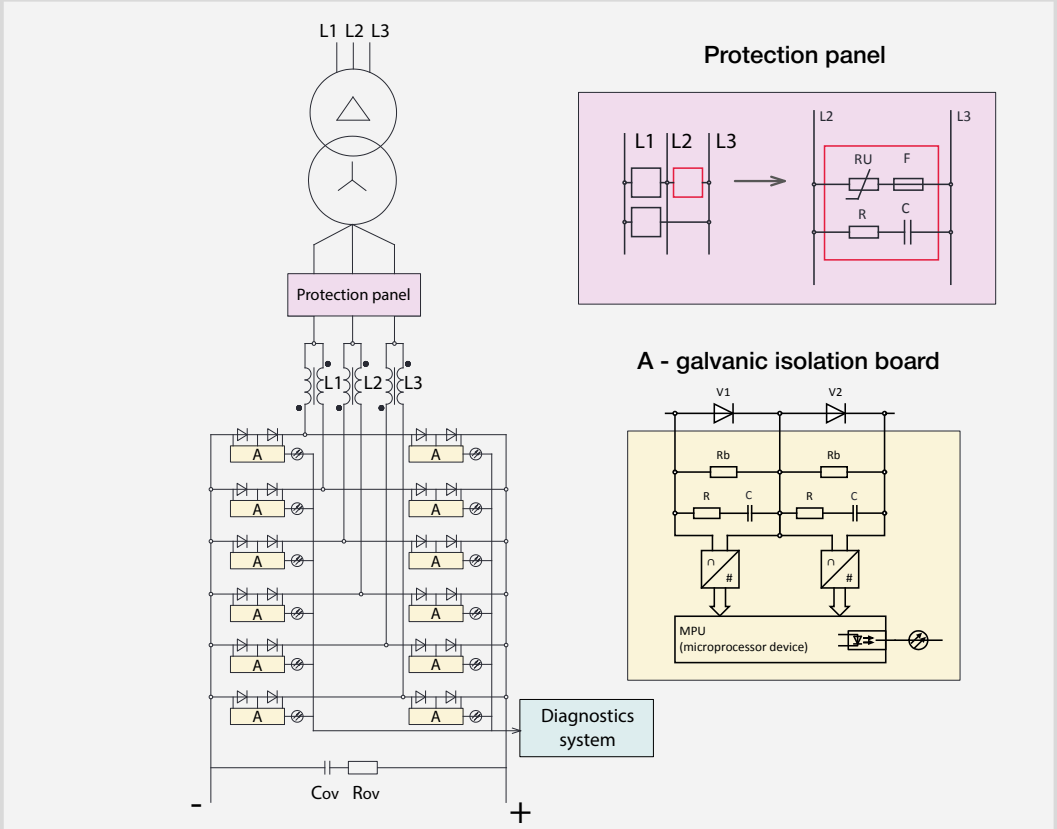


Rectifier 3300 V, 2000 A, with natural cooling,
Rectifier 3300 V, 3150 A, with forced cooling.
VI duty class acc. EN 50328
12-pulse rectification circuit. Outdoor installation

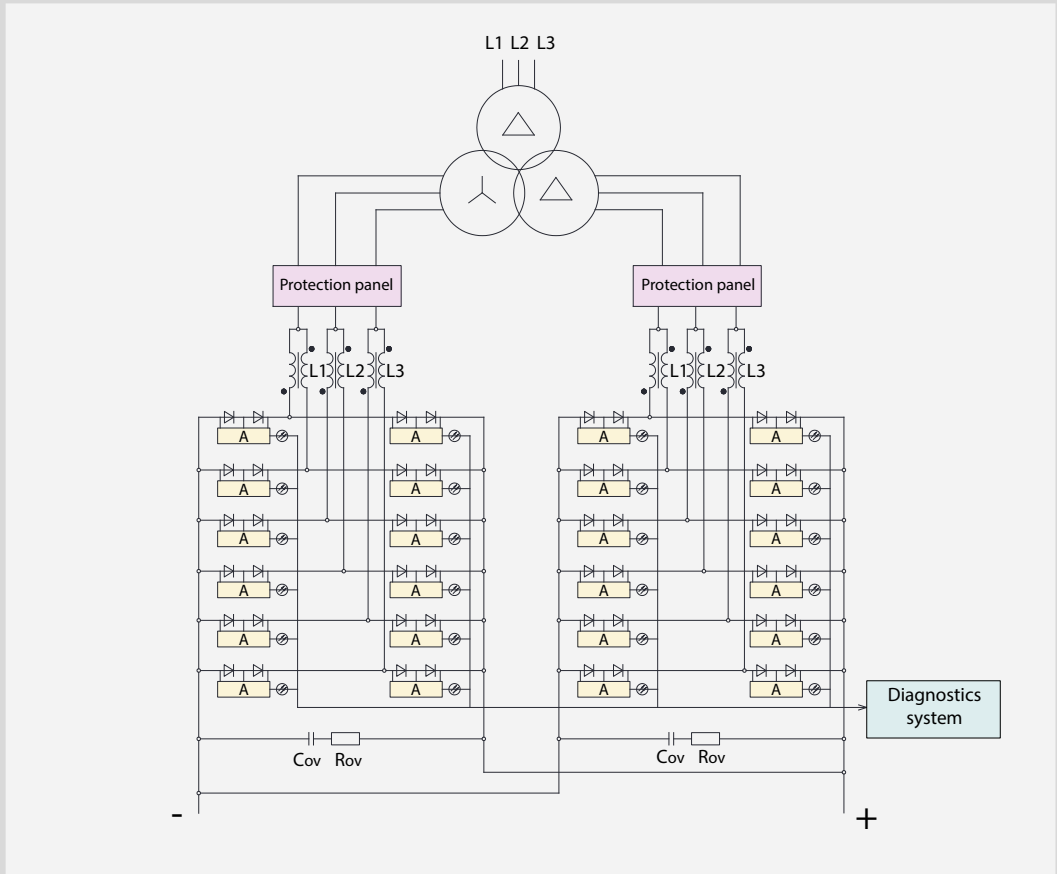


Rectifier diagnostics cabinet

Rectifiers power part circuits

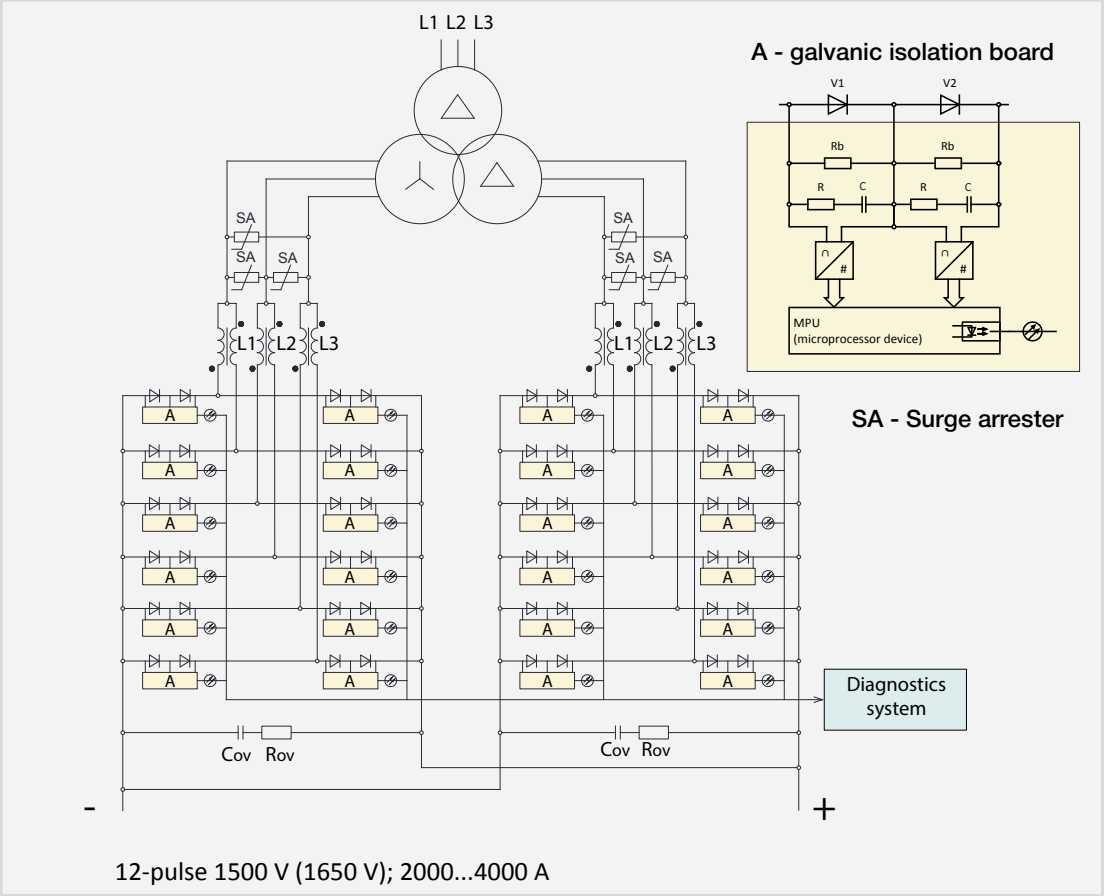


6-pulse 750 V (825 V); 1600...2000 A

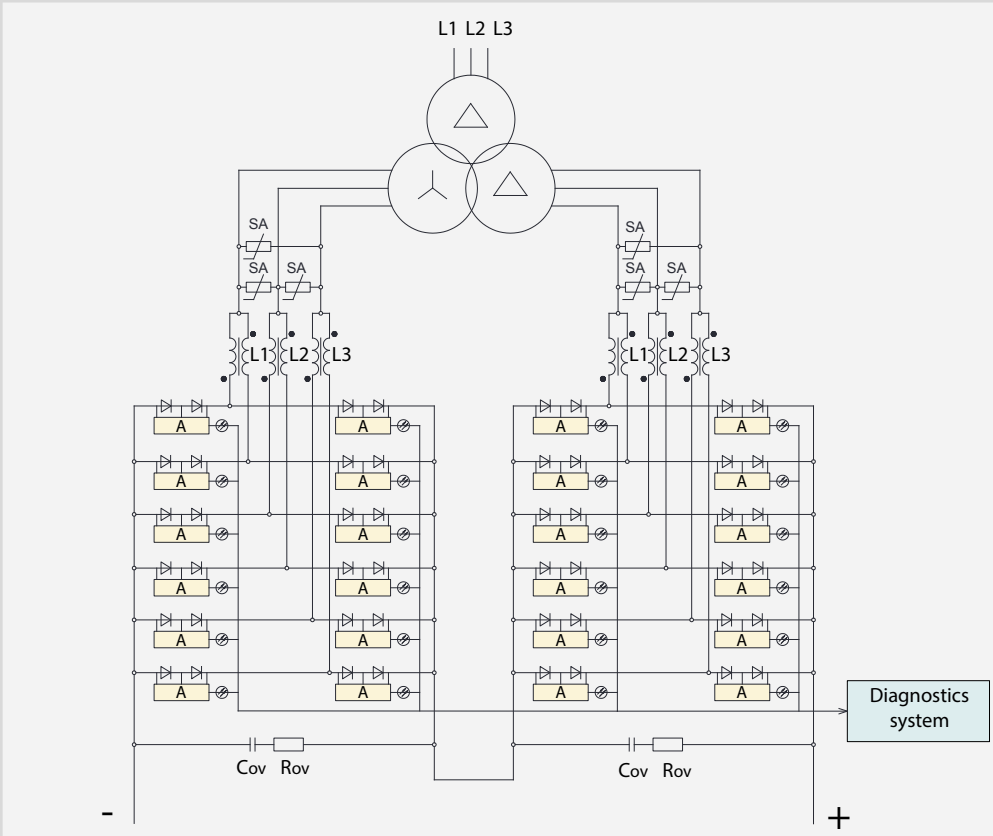


12-pulse 750 V (825 V); 2500...4000 A

Rectifiers power part circuits



12-pulse 1500 V (1650 V); 2000...4000 A



12-pulse 1500 V (1650 V), 3000 V (3300 V); 2000...4000 A

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