

GOOD PRACTICES IN SME

Replacing rectifiers



Designed by freepik

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What are rectifiers and where are they used?

A rectifier is a circuit converting alternating current (AC) using a step function and filtering into direct current (DC). Rectifiers are used in energy generation, powering appliance and devices (e.g. electric cars), electroplating and in most electric appliances powered from the energy network or any time of alternating current (e.g. the car's electric components). We make the distinction between half-wave and full-wave rectifiers, and between single-phase, three-phase or thyristor-controlled rectifiers

Source: Jakub Dawidziuk „Prostowniki”, 2012



Pic. 1 RS: three-phase bridge rectifier



Pic. 2 RS: half-wave bridge rectifier

How to choose a rectifier?

Three-phase rectifiers are characterized by much lower output voltage rippling in comparison to single-phase rectifiers. They also ensure higher smoothed output voltage for the same supply voltage. Moreover, three-phase circuits have a higher energy efficiency. In practice single-phase rectifiers are used in low power receivers (up to several kW). At higher power it is customary to use three-phase rectifiers. In half-wave circuits the current in the secondary wiring of the transformer connected to the converter significantly flow only through half the period. For this reason, transformer power significantly exceeds the power of the DC circuit. Additionally, due to the constant current source at the secondary wiring, these circuits experience unfavourable core magnetization, which decreases the efficiency of the rectifier and the entire circuit. In full-wave circuits the entire power input is used by the wiring, which results in better transformer power use.

Like all other devices the rectifier should be selected optimally regarding the receiver. At higher powers, due to significant losses, it is more cost-effective to use a higher performance rectifier. Six-pulse bridge circuits are the most common type of rectifier, primarily due to the economic balance between its cost and its output parameters. In this circuit the power of the primary and secondary wiring of the rectifier transformer are equal and take on the lower values possible for six-pulse systems. Achieve high voltages usually uses complex circuits with rectifiers connected in a series. Powering appliances with significant power demands uses complex circuits with parallel connected bridge rectifiers.

Source:: Elhand „Układy prostownikowe wielofazowe”; Andrzej Chochowski „Podstawy elektrotechniki i elektroniki dla elektryków Podręcznik część 2”, 2003

How much can be saved annually if replacing old rectifiers with high efficiency (95,7%) rectifiers in an AC/DC station, located in a climate controlled building?

Assumption: cost of electricity 0,55 PLN/kWh

Energy consumption in the building before the modernization [kWh/year]	Rectifier efficiency before the modernization					
	80%	81%	82%	83%	84%	85%
10 000	2 852 PLN	2 767 PLN	2 684 PLN	2 604 PLN	2 525 PLN	2 448 PLN
25 000	7 130 PLN	6 918 PLN	6 711 PLN	6 509 PLN	6 312 PLN	6 119 PLN
50 000	14 260 PLN	13 836 PLN	13 422 PLN	13 018 PLN	12 623 PLN	12 238 PLN
75 000	21 390 PLN	20 754 PLN	20 132 PLN	19 526 PLN	18 935 PLN	18 357 PLN
100 000	28 520 PLN	27 671 PLN	26 843 PLN	26 035 PLN	25 246 PLN	24 476 PLN
125 000	35 650 PLN	34 589 PLN	33 554 PLN	32 544 PLN	31 558 PLN	30 595 PLN
150 000	42 780 PLN	41 507 PLN	40 265 PLN	39 053 PLN	37 869 PLN	36 714 PLN
175 000	49 910 PLN	48 425 PLN	46 976 PLN	45 562 PLN	44 181 PLN	42 833 PLN
200 000	57 040 PLN	55 343 PLN	53 687 PLN	52 070 PLN	50 493 PLN	48 952 PLN

How much can be saved annually if replacing old rectifiers with high efficiency (95,7%) rectifiers in an AC/DC station, located in a non-climate-controlled building?

Assumption: cost of electricity 0,55 PLN/kWh

Energy consumption in the building before the modernization [kWh/year]	Rectifier efficiency before the modernization					
	80%	81%	82%	83%	84%	85%
10 000	1 128 PLN	1 043 PLN	960 PLN	879 PLN	800 PLN	723 PLN
25 000	2 820 PLN	2 607 PLN	2 400 PLN	2 198 PLN	2 001 PLN	1 809 PLN
50 000	5 639 PLN	5 215 PLN	4 801 PLN	4 397 PLN	4 002 PLN	3 617 PLN
75 000	8 459 PLN	7 822 PLN	7 201 PLN	6 595 PLN	6 004 PLN	5 426 PLN
100 000	11 279 PLN	10 430 PLN	9 602 PLN	8 794 PLN	8 005 PLN	7 235 PLN
125 000	14 098 PLN	13 037 PLN	12 002 PLN	10 992 PLN	10 006 PLN	9 043 PLN
150 000	16 918 PLN	15 645 PLN	14 403 PLN	13 191 PLN	12 007 PLN	10 852 PLN
175 000	19 738 PLN	18 252 PLN	16 803 PLN	15 389 PLN	14 009 PLN	12 661 PLN
200 000	22 557 PLN	20 860 PLN	19 204 PLN	17 588 PLN	16 010 PLN	14 469 PLN

Source: KAPE