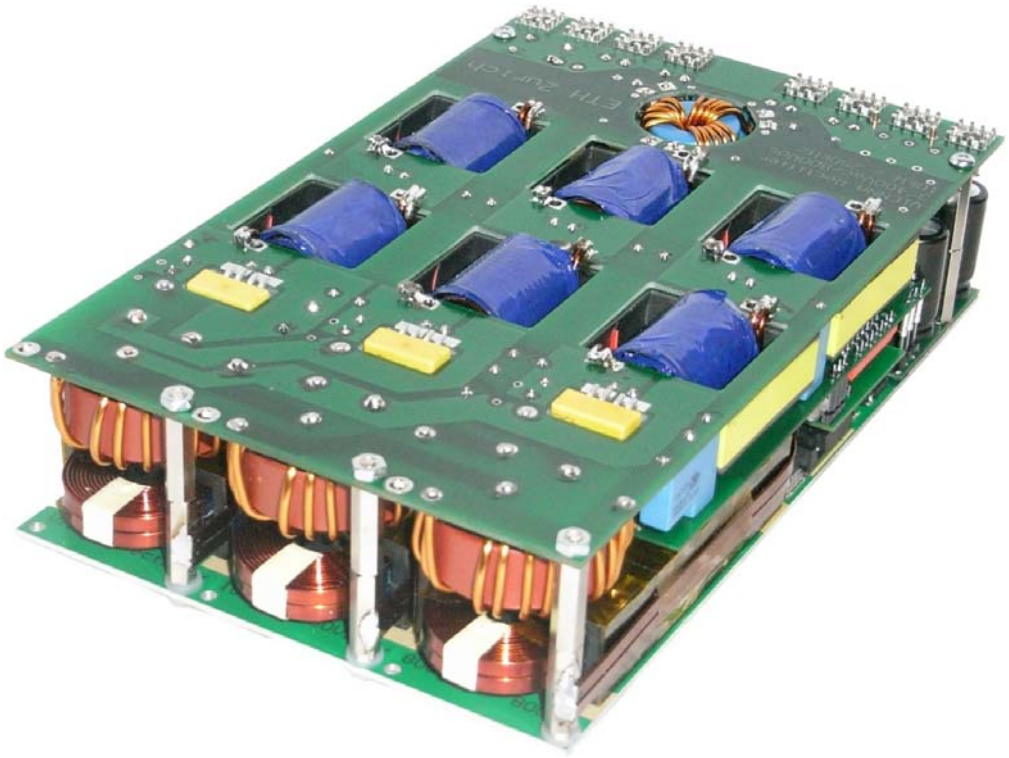
VIENNA Rectifier
Technology Package: VR250



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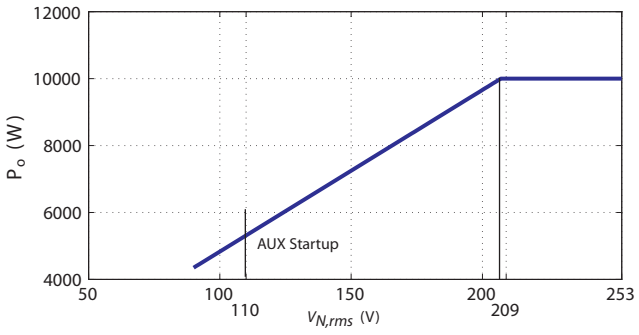
1 Technical Data

Characteristic	Rating
Dimensions (l x w x h)	195 mm x 120 mm x 42.7 mm 7.68 inch x 4.72 inch x 1.68 inch
Power density	10 kW/dm^3 (164 W/inch^3)
Weight (without cooler)	2.17 kg
(with cooler)	3.37 kg
Power-weight ratio	2.97 kW/kg
Switching frequency	250 kHz
Cooling	Forced air cooling
Controller	Fully digital control, implemented using an FPGA Lattice (Type: LFE2 – 20E)

Input:	
Input line-to-line voltage	320 V_{RMS} – 480 V_{RMS}
Input current	18 A_{RMS}
Maximum input current unbalance	± 10 % (symmetrical mains)
Input frequency	50 / 60 Hz (360 Hz – 800 Hz)
Power factor (@10kW)	> 0.99
THD_I of input currents	< 2 % (> 50% load, 50 Hz)
	< 1.2 % (@ full load, 50 Hz)

Output:	
Rated output power	10 kW
Rated output voltage	800 V_{DC} (±400 V)
Output power for two phase operation	57% $P_{o,nom}$
Overvoltage protection	±450 V_{DC}

Power limitation (V_o = 800 V):



Protecting functions:

By disabling all switching signals and turn-off of thyristors; system recovers after reset.

- Input overcurrent protection
- Output overvoltage protection
- Input voltage out of limits

  (Unit recovers automatically if voltage returns in specified range)
- Overtemperature

Control structure:

- Output voltage control
- Output voltage symmetry control
- Average current mode control of input currents
- 3rd harmonic injection
- Input voltage feed-forward
- Continuous operation at mains voltage unbalance with reduced output power

2 Structure of the Rectifier

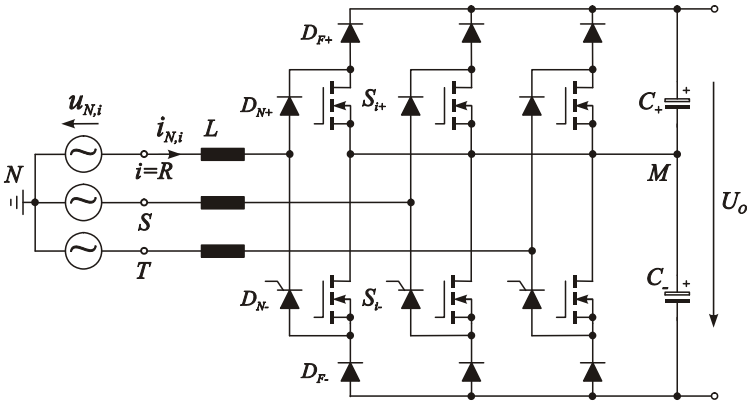


Fig. 1: Structure if the 6-switch Vienna-type PWM rectifier system.

The structure of the implemented 6-switch Vienna rectifier system is shown in Fig. 1. The 6-switch realization shows smaller conduction losses compared to the original Vienna rectifier (VR). Discrete semiconductors (CoolMOS-devices for the switches and SiC-diodes for the free-wheeling diodes) are used.

3 Performance of the System

3.1 Automatic Startup

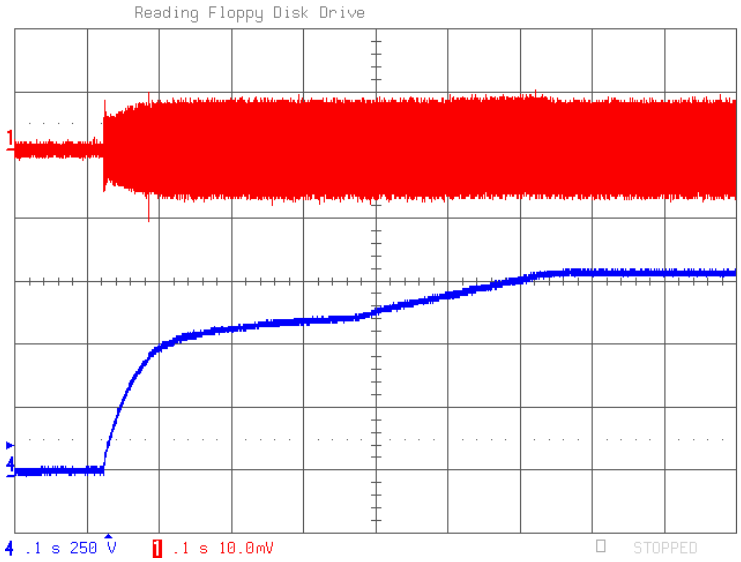
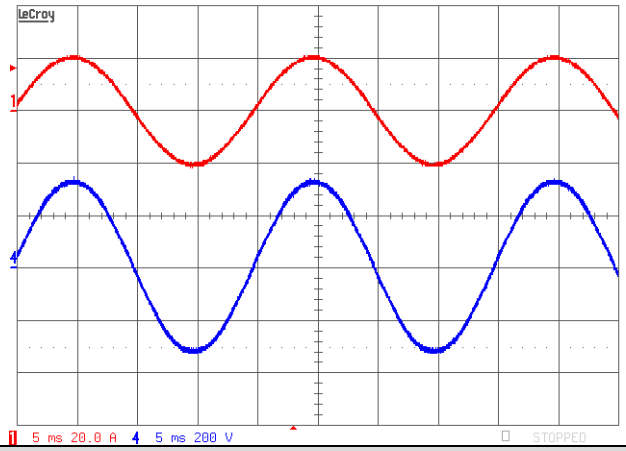


Fig. 2: Automatic startup of the rectifier system at f_N = 800 Hz; CH1 (red): I_N, 5 A/Div; CH4 (blue): V_o 250 V/Div.

3.2 Performance at 50 Hz

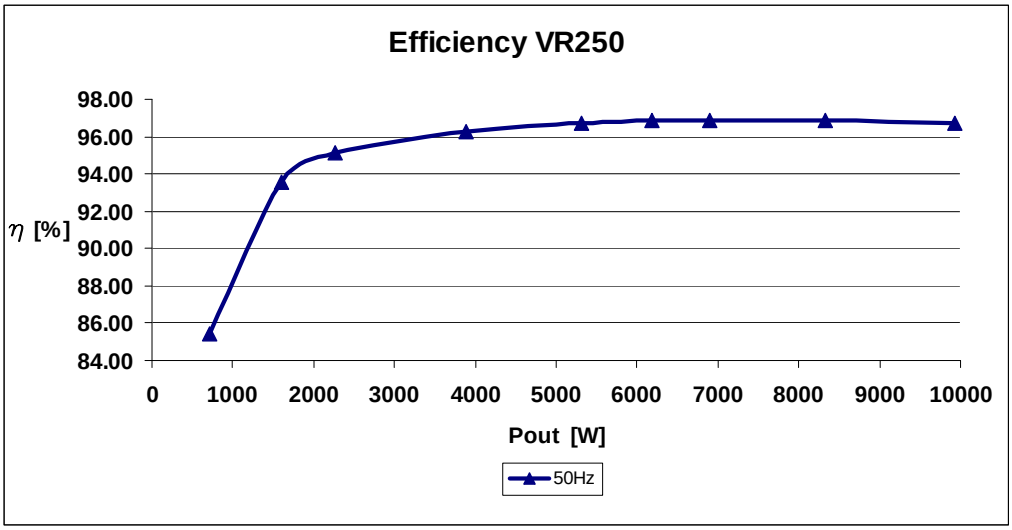
Performance at 50 Hz / 10 kW:



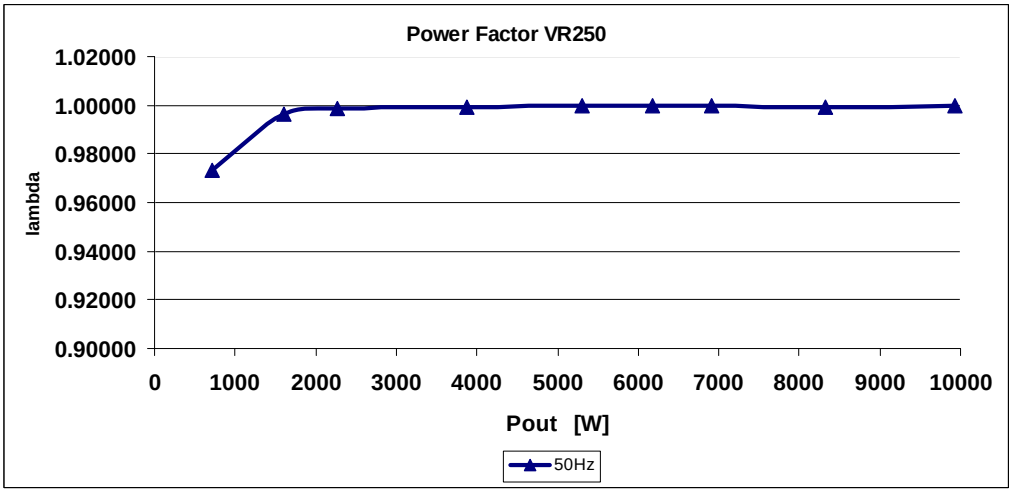
Input voltage: V_N = 230 V
Line frequency: f_{in} = 50 Hz
Output voltage: V_o = 800 V
Output power: P_o = 10 kW
THDI: THD = 0.9 %

Ch1 (red): I_N...20A/Div
Ch2 (blue): V_N...200V/Div
Timebase: 5ms/Div

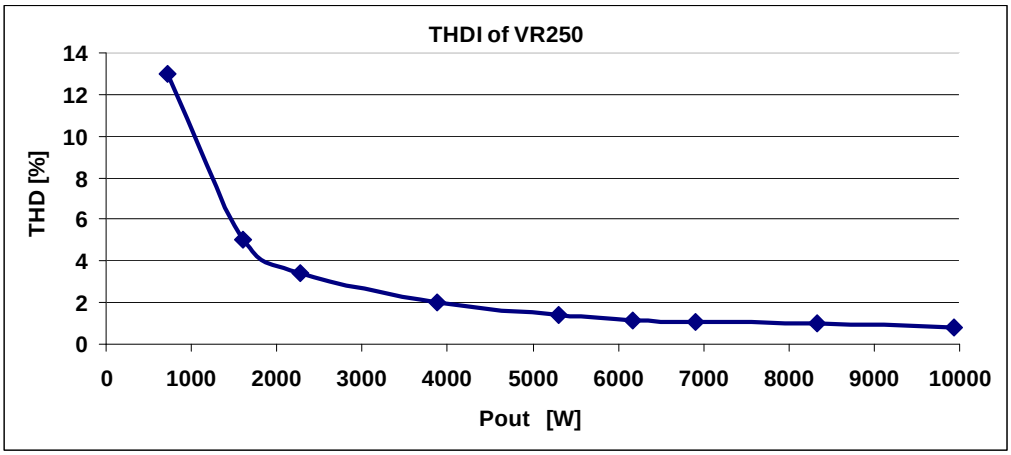
Efficiency:



Power factor:

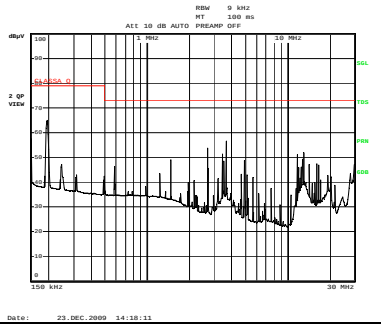


Input current quality:

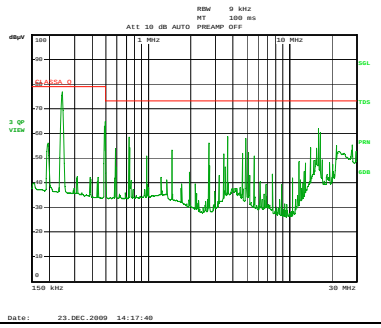


EMI Measurements:

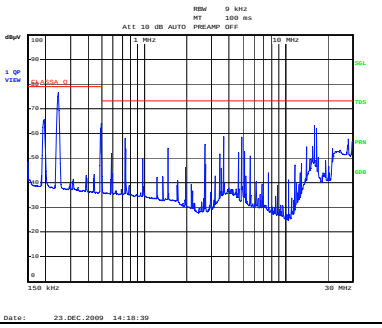
DM



CM

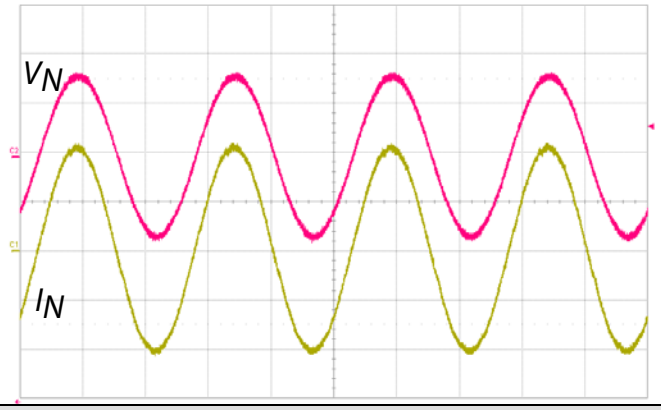


CM + DM



3.3 Performance at 400 Hz / 800Hz

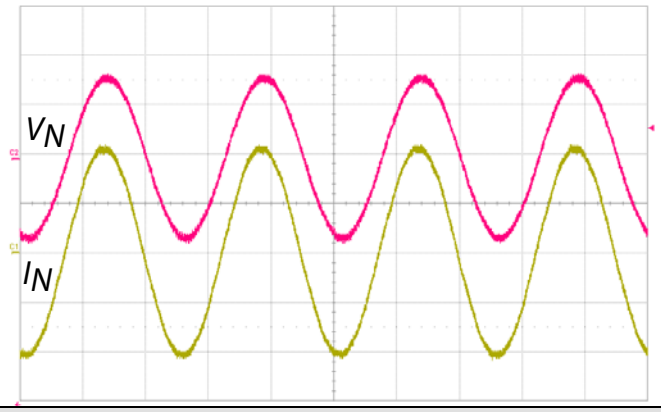
Performance at 400 Hz / 10 kW:



Input voltage: V_N = 230 V
Line frequency: f_{in} = 400 Hz
Output voltage: V_o = 800 V
Output power: P_o = 10 kW
THDI: THD = 1.4 %

Ch1 (yellow): I_N...10A/Div
Ch2 (red): V_N...200V/Div
Timebase: 1ms/Div

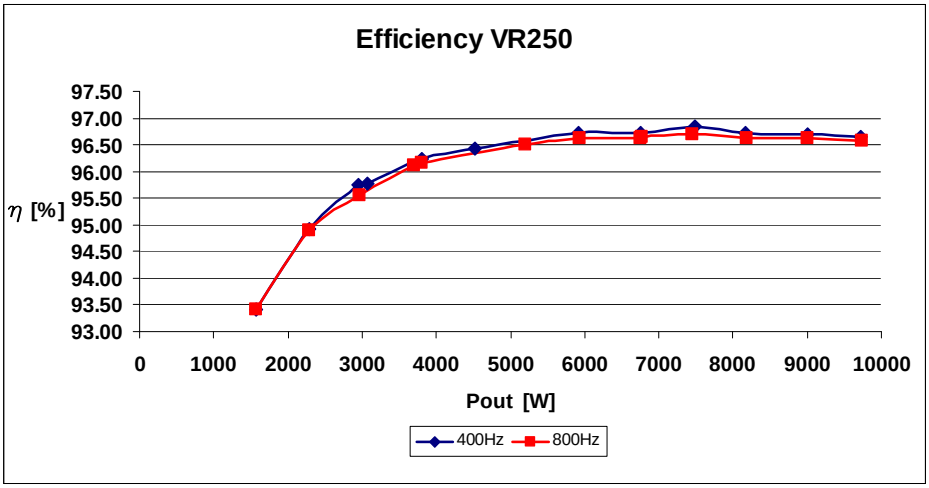
Performance at 800Hz / 10kW:



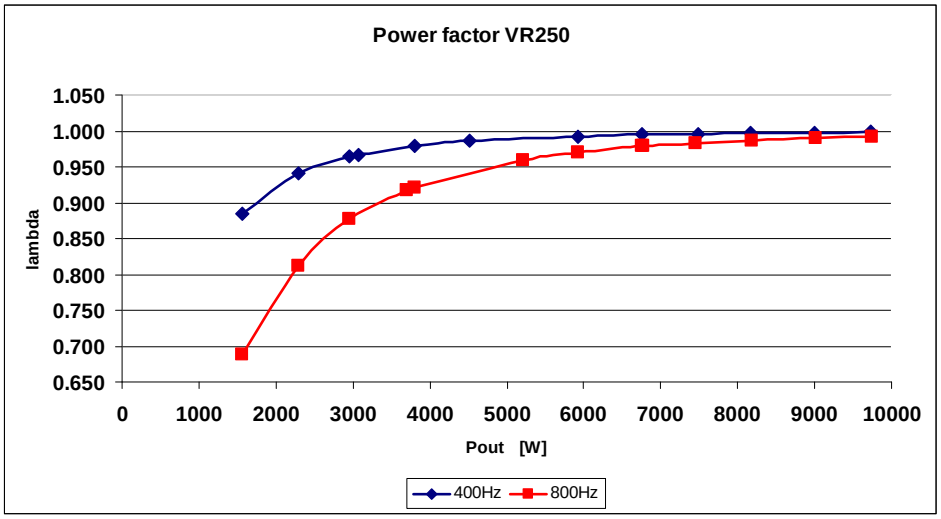
Input voltage: V_N = 230 V
Line frequency: f_{in} = 800 Hz
Output voltage: V_o = 800 V
Output power: P_o = 10 kW
THDI: THD = 1.6 %

Ch1 (yellow): I_N...10A/Div
Ch2 (red): V_N...200V/Div
Timebase: 0.5ms/Div

Efficiency:



Power factor:



Input current quality: