

# **Appendix C**

## **Turbine Specifications**

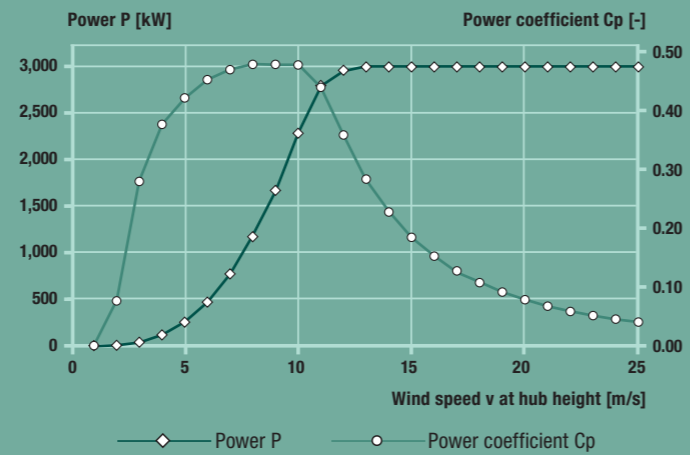


# E101

3,000 kW



## Calculated power curve



Wind [m/s]	Power P [kW]	Power coefficient Cp [-]
1	0.0	0.000
2	3.0	0.076
3	37.0	0.279
4	118.0	0.376
5	258.0	0.421
6	479.0	0.452
7	790.0	0.469
8	1,200.0	0.478
9	1,710.0	0.478
10	2,340.0	0.477
11	2,867.0	0.439
12	3,034.0	0.358
13	3,050.0	0.283
14	3,050.0	0.227
15	3,050.0	0.184
16	3,050.0	0.152
17	3,050.0	0.127
18	3,050.0	0.107
19	3,050.0	0.091
20	3,050.0	0.078
21	3,050.0	0.067
22	3,050.0	0.058
23	3,050.0	0.051
24	3,050.0	0.045
25	3,050.0	0.040

$\rho = 1.225 \text{ kg/m}^3$

For more information on the ENERCON power curve, please see the last page.

## Technical specifications E-101

Rated power: 3,000 kW  
 Rotor diameter: 101 m  
 Hub height: 99 m / 135 m  
 Wind zone (DIBT): WZ III  
 Wind class (IEC): IEC/NVN IIA

**WEC concept:** Gearless, variable speed  
 Single blade adjustment

### Rotor

Type: Upwind rotor with active pitch control  
 Rotational direction: Clockwise  
 No. of blades: 3  
 Swept area: 8,012 m<sup>2</sup>  
 Blade material: GRP (epoxy resin);  
 Built-in lightning protection  
 Rotational speed: Variable, 4–14.5 rpm  
 Pitch control: ENERCON single blade pitch system;  
 one independent pitch system per rotor blade with allocated emergency supply

### Drive train with generator

Hub: Rigid  
 Main bearing: Double-row tapered/cylindrical roller bearings  
 Generator: ENERCON direct-drive annular generator

**Grid feed:** ENERCON inverter

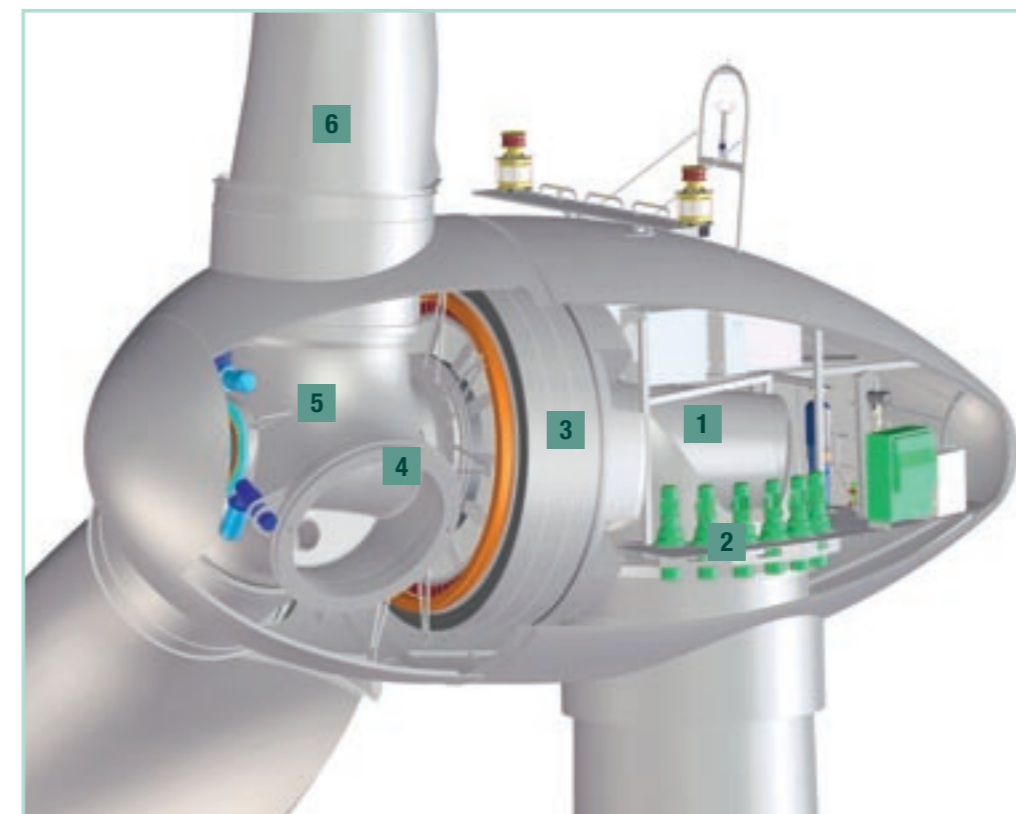
**Brake systems:** – 3 independent pitch control systems with emergency power supply  
 – Rotor brake  
 – Rotor lock, latching (15°)

**Yaw system:** Active via yaw gear, load-dependent damping

**Cut-out wind speed:** 28–34 m/s (with ENERCON storm control\*)

**Remote monitoring:** ENERCON SCADA

\*For more information on the ENERCON storm control feature, please see the last page.



- 1 Main carrier
- 2 Yaw drive
- 3 Annular generator
- 4 Blade adapter
- 5 Rotor hub
- 6 Rotor blade

## WIND ENERGY CONVERTER CHARACTERISTICS E-101

<b>Rotor</b>	
Type	E-101
Rotor diameter	101 m
Swept area	8012 m <sup>2</sup>
Power regulation	Pitch
RPM	4 – 14,5 min <sup>-1</sup>
Cut in wind	2,5 m/s
Cut out wind	28 – 34 m/s
Survival wind speed	59,5 m/s

<b>Gear Box</b>	
Not applicable	No gearbox

<b>Blades</b>	
Manufacturer	ENERCON
Blade length	48,5 m
Material	GRP (Epoxy)
Lightning protection	included

<b>Generator</b>	
Manufacturer	ENERCON
Nominal Power	3000 kW
Type (model)	Synchronous, direct-drive ringgenerator
Protection classification	IP 23
Insulation class	F

<b>Yaw System</b>	
Type	electrical motors
Yaw control	Active (based on wind vane signal)
Yaw rate	0,5°/sec

<b>Controller</b>	
Manufacturer	ENERCON
Type	microprocessor
Grid connection	Via ENERCON inverter
Remote communication	ENERCON Remote Monitoring System
UPS	included

<b>Braking System</b>	
Aerodynamic brake	<ul style="list-style-type: none"> <li>- three independent blade pitch systems with emergency supply</li> <li>- rotor brake</li> <li>- rotor lock, locking at 30°</li> </ul>

<b>Tower</b>			
Hub heights	99 m	135 m	
Tower	Prefab concrete	Prefab concrete	
Design Wind Class	<b>IIA</b>	<b>IIA</b>	

Sources: Design Assessment

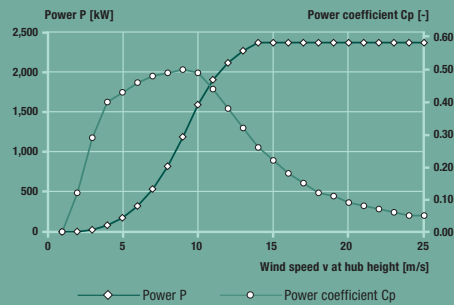
© by ENERCON GmbH. All rights reserved.			
Created/Date:	M. Lüninghöner	Checked:	AH/09/2009
Dpt.:	SL_HB	Approved:	SL_HB_WEC Characteristics_E-101_Rev001_eng-eng.doc
Revision:	001/31.03.2010	Reference :	

# E82

2,300 kW



## Calculated power curve



Wind [m/s]	Power P [kW]	Power coefficient Cp [-]
1	0.0	0.00
2	3.0	0.12
3	25.0	0.29
4	82.0	0.40
5	174.0	0.43
6	321.0	0.46
7	532.0	0.48
8	815.0	0.49
9	1,180.0	0.50
10	1,580.0	0.49
11	1,890.0	0.44
12	2,100.0	0.38
13	2,250.0	0.32
14	2,350.0	0.26
15	2,350.0	0.22
16	2,350.0	0.18
17	2,350.0	0.15
18	2,350.0	0.12
19	2,350.0	0.11
20	2,350.0	0.09
21	2,350.0	0.08
22	2,350.0	0.07
23	2,350.0	0.06
24	2,350.0	0.05
25	2,350.0	0.05

$\rho = 1.225 \text{ kg/m}^3$

For more information on the ENERCON power curve, please see the last page.

## Technical specifications E-82 E2

Rated power: 2,300 kW  
 Rotor diameter: 82 m  
 Hub height: 78 m / 85 m / 98 m / 108 m / 138 m  
 Wind zone (DIBT): WZ III  
 Wind class (IEC): IEC/NVW IIA

**WEC concept:** Gearless, variable speed  
 Single blade adjustment

### Rotor

Type: Upwind rotor with active pitch control  
 Rotational direction: Clockwise  
 No. of blades: 3  
 Swept area: 5,281 m<sup>2</sup>  
 Blade material: GRP (epoxy resin);  
 Built-in lightning protection  
 Rotational speed: Variable, 6–18 rpm  
 Pitch control: ENERCON single blade pitch system;  
 one independent pitch system per rotor blade with allocated emergency supply

### Drive train with generator

Hub: Rigid  
 Main bearing: Double-row tapered/cylindrical roller bearings  
 Generator: ENERCON direct-drive annular generator

**Grid feed:** ENERCON inverter  
**Brake systems:** – 3 independent pitch control systems with emergency power supply  
 – Rotor brake  
 – Rotor lock

### Yaw system:

Active via yaw gear, load-dependent damping  
**Cut-out wind speed:** 28–34 m/s (with ENERCON storm control\*)

**Remote monitoring:** ENERCON SCADA

\* For more information on the ENERCON storm control feature, please see the last page.



- 1 Main carrier
- 2 Yaw drive
- 3 Annular generator
- 4 Blade adapter
- 5 Rotor hub
- 6 Rotor blade

## WIND ENERGY CONVERTER CHARACTERISTICS

### E-82 E2 2.3MW

<b>Rotor</b>	
Type	E82 E2
Rotor diameter	82 m
Swept area	5281 m <sup>2</sup>
Power regulation	Pitch
RPM	6 – 18 min <sup>-1</sup>
Cut in wind	2,5 m/s
Cut out wind	28 – 34 m/s
Survival wind speed	59,5 m/s

<b>Gear Box</b>	
Not applicable	No gearbox

<b>Blades</b>	
Manufacturer	ENERCON
Blade length	38,8 m
Material	GRP (Epoxy)
Lightning protection	included

<b>Generator</b>	
Manufacturer	ENERCON
Nominal Power	2300 kW
Type (model)	Synchronous, direct-drive ringgenerator
Protection classification	IP 23
Insulation class	F

<b>Yaw System</b>	
Type	6 electrical motors
Yaw control	Active (based on wind vane signal)
Yaw rate	0,5°/sec

<b>Controller</b>	
Manufacturer	ENERCON
Type	microprocessor
Grid connection	Via ENERCON inverter
Remote communication	ENERCON Remote Monitoring System
UPS	included

<b>Braking System</b>	
Aerodynamic brake	<ul style="list-style-type: none"> <li>- three independent blade pitch systems with emergency supply</li> <li>- rotor brake</li> <li>- rotor lock, locking at 30°</li> </ul>

<b>Tower</b>					
Hub heights	78 m	85 m	98 m	108 m	138 m
Tower	Steel (4 + FS)	Steel + Prefab concrete (2 + 15)	Steel + Prefab concrete (2 + 18)	Steel + Prefab concrete (2 + 21)	Steel + Prefab concrete (2 + 21)
Design Wind Class	II	II	II	II	II

<b>Weights</b>	
Nacelle, excl. Rotor and hub	Approx. 18 to
Rotor incl. Hub/Main pin	Approx. 55 to
Generator	Approx. 62 to
<b>Total Weight</b>	<b>Approx. 135 to</b>

*Sources: Design Assessment, Manufacturers Certificate*