

# ESTIMATION OF POWER QUALITY



According to IEC 61400-21: Wind turbine generator system, of 12.2001

<b>Report:</b>	<b>NR 08 029</b>	<b>Sheet:</b>	<b>NR 08 029.001</b>	<b>page 1 of 3</b>
<b>Wind turbine type designation:</b>	<b>WTN 600</b>	Serial number		
<b>Name of test organisation:</b>	DEWI GmbH Deutsches Windenergie- Institut Ebertstr. 96, D-26382 Wilhelmshaven, Germany			
<b>Wind turbine manufacture:</b>	Windtechnik-Nord Enger Strasse 13 D-25917 Enge-Sande			

<b>Description of the tested wind turbine, including settings of control parameters:</b>	Document name and date/ Manufacturer specification of: WTN 600
<b>Description of the test side and grid connection:</b>	-
<b>Description of the test equipment:</b>	-
<b>Description of test conditions:</b>	-
<b>Measurement period:</b>	-

### Note of exceptions to IEC 61400-21:

The given values of this data sheet are not based on power quality measurements at the WTN 600 as it is required by IEC 61400-21. They are based on an estimation, which is performed on the basis of the experience of power quality measurements at similar wind turbines and of the theoretical investigations of the main specifications of the WTN 600.

### Remarks:

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### General Data:

<b>Number of blades:</b>	3	<b>Generator type and rating(s):</b>	asynchronous, 2 x 330 kW
<b>Rotor diameter [m]:</b>	48 m	<b>Frequency converter type rating:</b>	ABB Full converter ACS 800-77- 2x0580/0940-7
<b>Hub height [m]:</b>	66 m	Special features:	
<b>Blade control (pitch/stall):</b>	pitch		
<b>Speed control (fixed/2speed/variable):</b>	variable		

### Rated Data:

<b>Rated power, <math>P_n</math>:</b>	600 kW	<b>Rated apparent power, <math>S_n</math>:</b>	602 kVA
<b>Rated wind speed, <math>v_n</math>:</b>	12 m/s	<b>Rated reactive power, <math>Q_n</math>:</b>	50 kvar
<b>Rated voltage, <math>U_n</math>:</b>	690 V	<b>Rated current, <math>I_n</math>:</b>	504 A

**Maximum power and assessed reactive power:**

Max. permitted power, $P_{mc}$ :		Max. 60 sec. average		Max. 0.2 sec. average	
$P_{mc}$ 610 kW	$p_{mc}=P_{mc}/P_n$ 1.02	$P_{60}$ 630 kW	$p_{60}=P_{60}/P_n$ 1.05	$P_{0.2}$ 690 kW	$p_{0.2}=P_{0.2}/P_n$ 1.15
$Q_{mc}$ at $P_{mc}$ 55 kvar	$Q_{mc}/P_n$ [kvar/kW] 0.09	$Q_{60}$ at $P_{60}$ 60 kvar	$Q_{60}/P_n$ [kvar/kW] 0.10	$Q_{0.2}$ at $P_{0.2}$ 70 kvar	$Q_{0.2}/P_n$ [kvar/kW] 0.12

**Reactive power:**

Output power bin $P/P_n$		Active power bin-mean-value [kW]	Reactive power bin-mean-value [kvar]
from	to		
-0.05	<0.05	0	10
0.05	<0.15	60	10
0.15	<0.25	120	12
0.25	<0.35	180	13
0.35	<0.45	240	16
0.45	<0.55	300	20
0.55	<0.65	360	24
0.65	<0.75	420	30
0.75	<0.85	480	37
0.85	<0.95	540	44
0.95	<1.05	600	50

**Harmonics:**

Order	Harmonic current: [% of $I_n$ ]	Output power [kW]	Order	Harmonic current: [% of $I_n$ ]	Output power [kW]	Order	Harmonic current: [% of $I_n$ ]	Output power [kW]
2	1.0		3	0.9		4	0.2	
5	1.2		6	0.2		7	1.5	
8	0.2		9	0.8		10	0.2	
11	1.6		12	0.2		13	1.5	
14	0.2		15	0.5		16	0.2	
17	0.6		18	0.2		19	0.4	
20	0.2		21	0.3		22	0.1	
23	0.5		24	0.1		25	0.4	
26	0.1		27	0.1		28	0.1	
29	0.3		30	0.1		31	0.2	
32	0.1		33	0.1		34	0.1	
35	0.1		36	0.1		37	0.1	
38	0.1		39	0.1		40	0.1	
41	0.1		42	0.1		43	0.1	
44	0.1		45	0.5		46	0.5	
47	0.1		48	0.1		49	0.1	
50	0.1							
Maximum total harmonic current distortion:[% of $I_n$ ]			3.6		Output power at maximum total harmonic current distortion [kW]:			

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**Flicker:**

Network impedance phase angle, $\psi_k$ :	30°	50°	70°	85°
Annual average wind speed, $v_a$ (m/s):	Flicker coefficient, $c(\psi_k, v_a)$ :			
6.0 m/s	8	8	8	8
7.5 m/s	8	8	8	8
8.5 m/s	8	8	8	8
10.0 m/s	8	8	8	8

**Switching operations:**

Case of switching operation:	Start-up at cut in wind speed			
Maximum number of switching operations, $N_{10}$ :	12			
Maximum number of switching operations, $N_{120}$ :	120			
Network impedance phase angle, $\psi_k$ :	30°	50°	70°	85°
Flicker step factor, $k_f(\psi_k)$ :	0.2	0.2	0.2	0.2
Voltage change factor, $k_u(\psi_k)$ :	0.4	0.4	0.3	0.3

Case of switching operation:	Start up at rated wind speed			
Maximum number of switching operations, $N_{10}$ :	1			
Maximum number of switching operations, $N_{120}$ :	12			
Network impedance phase angle, $\psi_k$ :	30°	50°	70°	85°
Flicker step factor, $k_f(\psi_k)$ :	0.4	0.4	0.4	0.4
Voltage change factor, $k_u(\psi_k)$ :	1.0	0.8	0.7	0.5

**Worst case switching between generators:**

Case of switching operation:	From 1 <sup>st</sup> to 2 <sup>nd</sup> generator			
Maximum number of switching operations, $N_{10}$ :	12			
Maximum number of switching operations, $N_{120}$ :	120			
Network impedance phase angle, $\psi_k$ :	30°	50°	70°	85°
Flicker step factor, $k_f(\psi_k)$ :	0.3	0.3	0.3	0.3
Voltage change factor, $k_u(\psi_k)$ :	0.7	0.5	0.4	0.4

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