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**Measurement and assessment of power quality characteristics of
wind turbines generator systems**

(IEC 61400-21 :2008 ,Wind turbines—
Part 21 :Measurement and assessment of power quality characteristics
of grid connected wind turbines ,IDT)



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5 3
maximum measured power for wind turbines

3 6
network impedance phase angle

$$\psi = \arctan \left(\frac{X}{R} \right)$$

X
 R

3 7
normal operation for wind turbines

3 8
operational mode for wind turbines

3 9
output power for wind turbines

1 3 0
point of common coupling PCC

11 3
power collection system for wind turbines

12 3
rated apparent power for wind turbines

$$S = \sqrt{P^2 + Q^2}$$

1 3 6

standstill for wind turbines

1 3 7

start up for wind turbines

1 3 8

switching operation for wind turbines

1 3 9

turbulence intensity

2 3 0

voltage change factor for wind turbines

$$k(\psi) = \sqrt{\frac{U - U}{U}} \times \frac{S}{S}$$

U

U

U

S

S

k

k

k

k

k

21 3

wind turbine WT

22 3

wind turbine terminals

4

$$\frac{U}{U}$$

ψ

α_t

β

c_ψ

E_i

f

$f_i \quad i$

f

f

$f_i \quad i$

h

$l_{hi} \quad i$

h

i_t

l

k_ψ

k_i

k_ψ

L

N

N

$N \quad v$

$n_i \quad i$

N

$N_i \quad i$

$N_{icx} \quad i$

x

N

P

P

P

P

P

P_{cx}

c

P

P

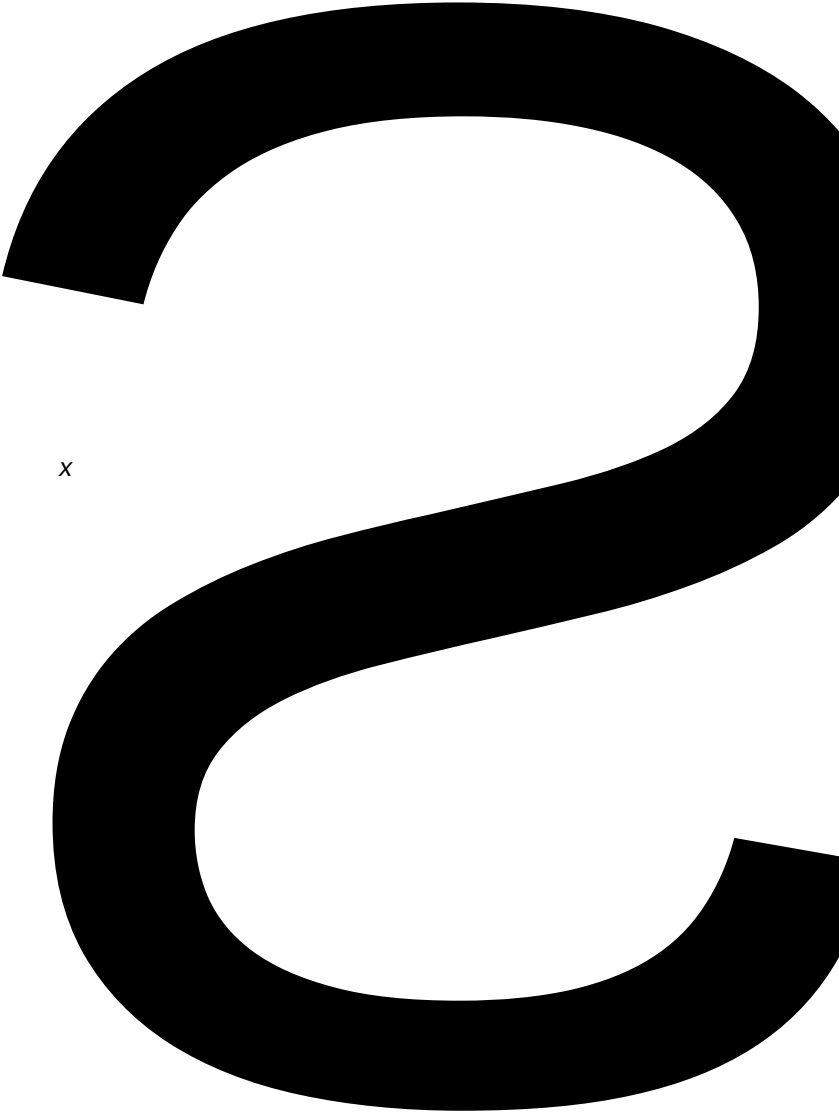
Q

R

S

S

S



U

U

U

v

v

v_i i

w_i i

X

Z

Z

$$\cdot \quad 263 \quad - \quad \vdash$$

$$v$$

$$\psi$$

$$c \quad \psi \quad v$$

$$Q$$

$$F(v) = \quad - \quad - \quad -$$

$$=$$

06887980 0000 CE-SP-VI • SVN E I E K C H IV =G#A 6 I AN J X F H -I R η , Λ T T S H • V λ C > 3 x f α . i v λ c > 2 #

6 9

7

1 7

1 7

1

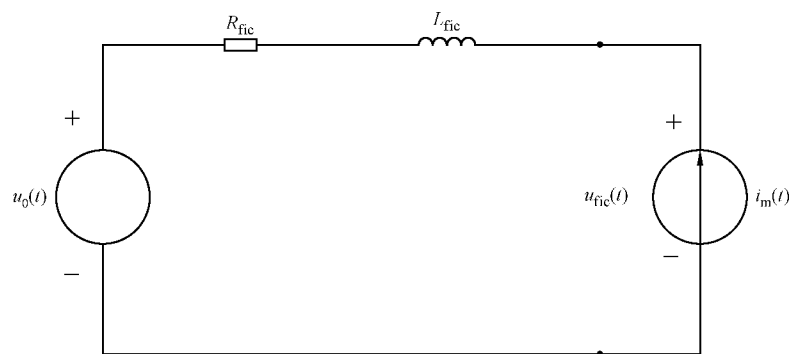
2

$$L = I - U$$

0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31 32 33 34 35 36 37 38 39 40 41 42 43 44 45 46 47 48 49 50 51 52 53 54 55 56 57 58 59 60 61 62 63 64 65 66 67 68 69 70 71 72 73 74 75 76 77 78 79 80 81 82 83 84 85 86 87 88 89 90 91 92 93 94 95 96 97 98 99

l t -

2



4

$u \quad t$
 $i \quad t \quad i \quad t$

$R \quad L$

u t

$$\frac{N_i}{N} = \frac{f_i}{f}$$

$$f_i = \frac{N_i}{N}$$

$$w_i = \frac{f_i}{f}$$

$$c = \psi \cdot v$$

$$P(c|x) = \frac{\sum_{i=1}^N w_i \times N_{i,c,x}}{\sum_{i=1}^N w_i \times N_i}$$

$$\frac{N_{i,c,x}}{N}$$

$$x$$

$$P(c|x)$$

1

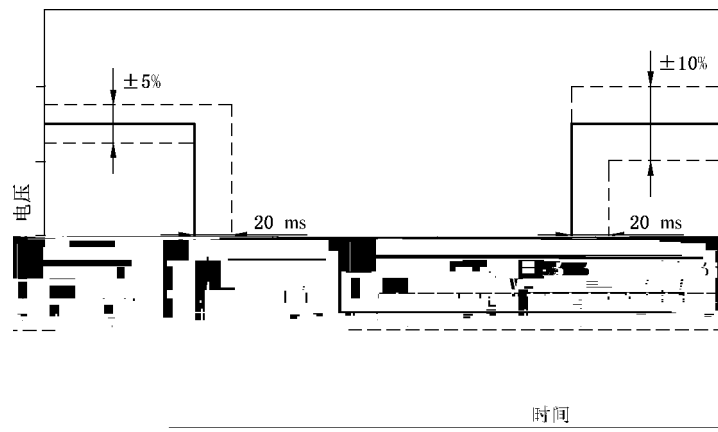
2

3 P

T

4

7 4



6

P

P

P

7 6

1 7 6

P

P

P

7 6 3

7 7

1 7 7

2 7 7

$$P_{\psi} = P_{\psi} = c(\psi - v) \times \frac{S}{S}$$

$$\begin{matrix} c & \psi & v \\ S & & \\ S & & \end{matrix} \qquad \qquad \qquad \psi \qquad \qquad \qquad v$$

$$k \quad \psi \quad \vdash \quad \psi$$

1
2

3 8

A

	N				
	N				
	ψ				
	$k \ \psi$				
	$k \ \psi$				

Б λ "



A

2 3

[illegible]

A

33

P											
f	l_h	a_4	O_f								

A

4

96

M0

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P

P

P

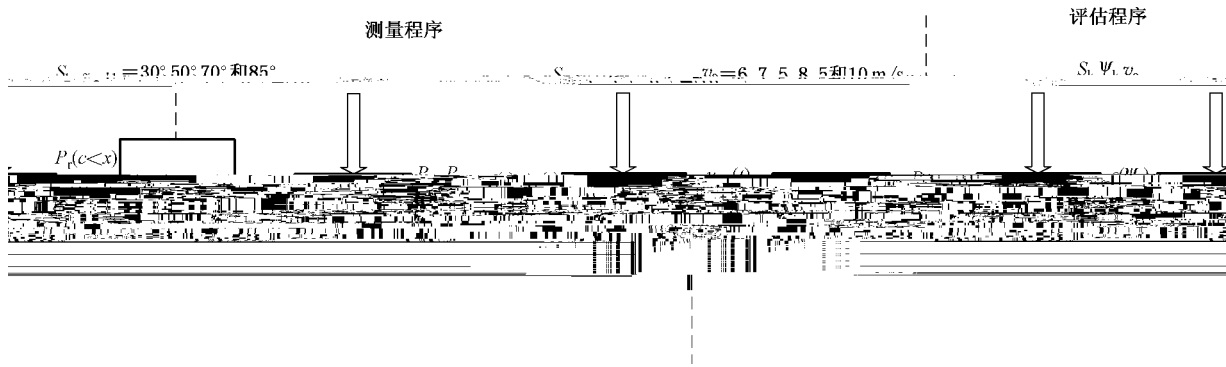
A 5 3

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A 8

B

B 1



B 1

u t i t
S

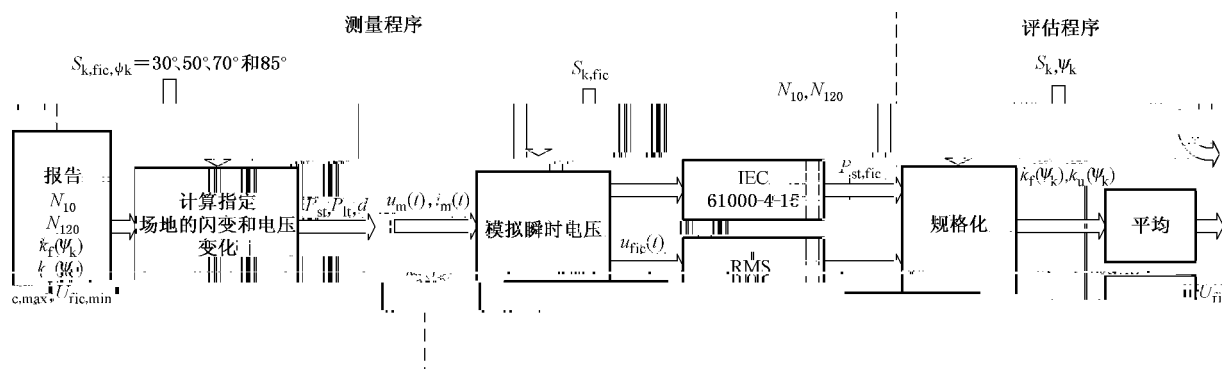
ψ

u t

u t

P

P



B

2

u t i t
S

ψ

u t
u t

P

U

U

P

$$C \quad \psi \quad V$$

$C \psi$

$$W_i$$

$$P \quad c \quad x$$

$$C \quad \psi \quad V$$

V

$$C \quad \psi \quad V$$

$$f_i \quad v$$

f_i

B 1 m s 15 /

m m y

[illegible]

$\frac{1}{2}$ TM

" TM

B 2

	w_i	w_i	w_i	w_i

B 3

v				
$\sum_{i=1}^N w_i \times N_i$				

TM

$c \psi$
 $c \psi$

TMTM

$c \psi$

TM

TM

P_{TM}^c

TM

TM

B 4

		<i>P c x</i>	<i>P c x</i>	<i>P c x</i>	<i>P c x</i>
1	5 90 0			99 0 0 0	
	5 8 8 8		299 0 0		

c ψ ν

B 5

<i>ψ</i>				
<i>ν</i>				

┆ - ┆ - ┆

$$B \qquad \qquad \qquad 4$$

$$B \qquad \qquad \qquad 1 \quad 4$$

$$P \qquad \psi \qquad \qquad \qquad P \qquad \qquad \qquad \psi \qquad \qquad \qquad P \qquad \qquad \qquad S$$

$$P \qquad = c(\psi) \times \frac{S}{S}$$

$$S$$

$$c \, \psi$$

$$c(\psi) = P \qquad \times \frac{S}{S}$$

$$B \qquad \qquad \qquad 2 \quad 4$$

$$F$$

$$k \, \psi$$

$$d \qquad = k \, (\psi) \times \frac{S}{S} \times$$

$$d$$

$$d \qquad \qquad \qquad t$$

$$t \qquad = \qquad . \times d$$

$$P$$

$$P \qquad = \left(\frac{t}{T} \right)$$

$$\acute{u} \quad K! \quad T$$

GB T ≠ 2 2 2 1/0 03 0

$$k\left(\psi\right)=\sqrt{}\times\frac{U}{U}-\frac{U}{U}\times\frac{S}{S}$$

U
U

u t
u t

с

- ъ

$$U = \sqrt{-(u + u)}$$
