

## **THREE PHASE CAPACITOR For WIND TURBINES**

### **Applications:**

Three-phase capacitor for Wind Turbine has been designed for power factor correction in high harmonic current content.

### **Technology:**

The capacitor has been made by three elements putted in star connection to keep as low as possible the stress voltage on the film. The elements are housed into an aluminium can and finally impregnated by natural oil.

### ***Electrical Characteristics:***

Each element is made by Metallized Polypropylene.

- The metallization has been made in a special “profile” to allow:
  - an higher voltage stress on the film
  - an higher operating over-voltage
  - a better way to control the self-healing
  - an heavy edge to improve the contact from the active area and the spraying head to reach an higher inrush current (more than 300 times rated current)
  - very low losses (less than 0,2 W/kVAr)
- The impregnation technology allow:
  - to treat the capacitor in a vacuum
  - to eliminate gas and humidity from the active area
  - impregnate the element
  - to control the “partial discharge effect” which is one of the reason to have precocious ageing (life longer than 120.000 operating hours)

### ***Mechanical Characteristics:***

- the capacitor is equipped with an over-pressure device which allow to protect itself from the destructive short circuit coming from an electrical or thermal over-load
- this over-pressure device works on all the three phases
- the oil is the best to transmit to the mechanical safety device, in a shortest way, the over-pressure coming from a destructive short-circuit.

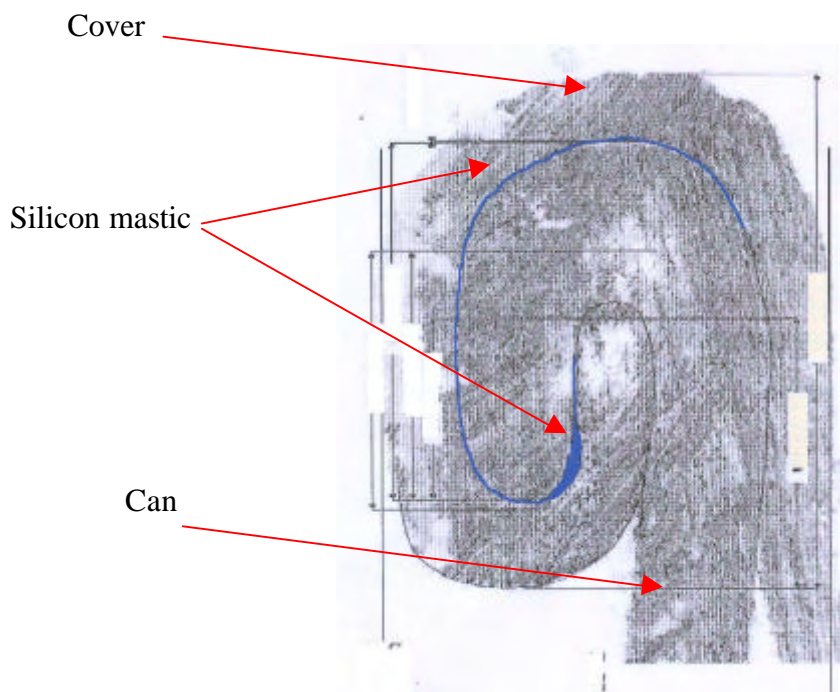
### **More details**

### **Claw profile**

The capacitor has been equipped with a new claw profile to assure that no leakage can occur during all capacitor's life.

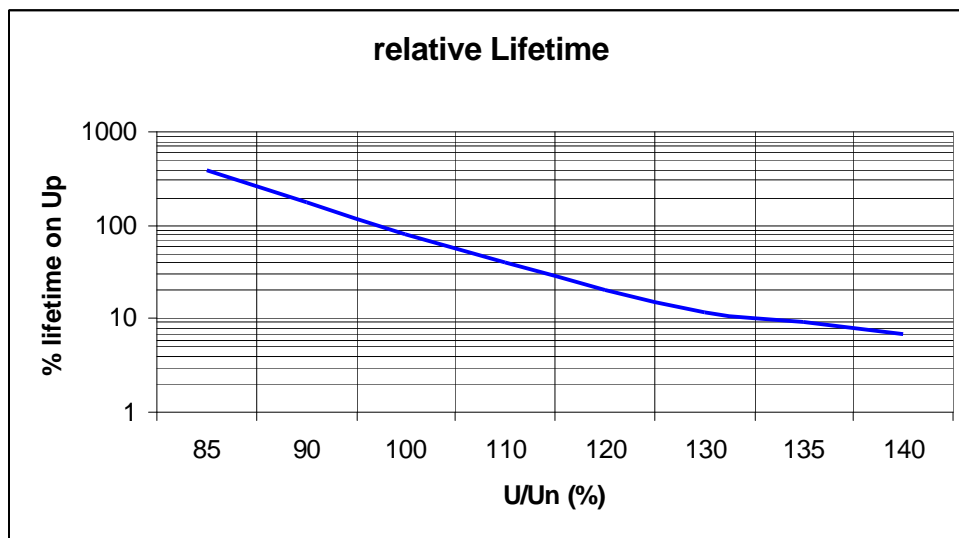
The mastic, is spread just before clawing, so it can run through all the space from cover and can.

The mastic is made by silicon. After a few minutes, the mastic join cover and can and the oil, that fill the capacitor, can't go outside.



The picture has been taken from a real capacitor by microscope

## Endurance test



To be sure that the capacitor can withstand the expected life (more than 120.000 h), we have put, itself, under:

- 1,25 Un
- 1,35 Un

The nominal stress, on the film, has been fixed at 62 v/μm to give its a little margin. In fact the curve, shown in the picture, has been calculated with capacitor putting under a 66 v/μm stress.

Capacitor type:

Un=760 Vac (Star connection)

Adopted Film Thickness= 7 μm (→ 62 v/μm)

For Un= 800 (Star connection)

Adopted Film Thickness= 7,5 μm (→ 61,5 v/μm)

DUCATI energia	CAPACITOR for THREE - PHASE POWER FACTOR CORRECTION	Qn = 30kVAR 760Uac
S.p.A		Part. Number : 216371900

## CHARACTERISTICS

Power	30	kVar
Rated Capacitance	3x165,3	µF
Capacitance Tolerance	-5+5%	
Rated Voltage Un	760	V
Rated frequency	50	Hz
Rated Current (In)	22,8	A
Dielectric	PP film	Self healing
Dielectric losses	< 0.4	W/kVar
Connection	Y	
Overpressure safety device		
Aluminium case		
Impregnant	Castor oil	Non PCB

## Equipment

Discharge resistors	None
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## MAXIMUM RATINGS

Overvoltage	1.1 Un	8 hours/day
	1.15 Un	30min/day
	1.2 Un	5min/200times
	1.3 Un	1min/200times
Overcurrent:	1,3 In	
Inrush current:	300 In	

## TEST DATA

AC Test voltage terminal to terminal	2,15 Un	Vac (2 sec)
AC test voltage terminal to case	6000	Vac (10 sec)

## CLIMATIC CATEGORY

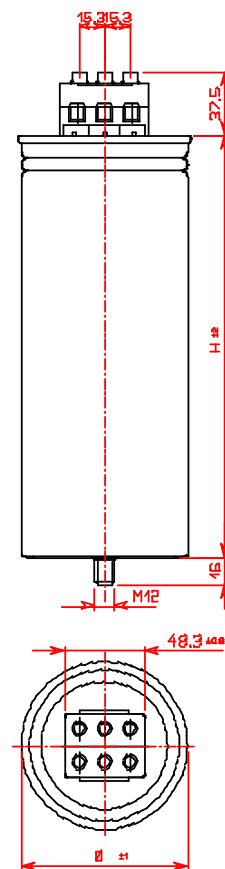
Temperature class (ambient)	-25/D	(max 55°C)
Storage temperature	-55 +70	°C
Altitude maximum	2000m	a.s.l.

Failure quota	300/10E9
Expected life (Ln)	>150000h

<b>Standards:</b>	EN60831-1
	EN60831-2
Degree of protection:	IP20 indoor mounting

Humidity category	in accord. with DIN 40040	F
Self-extinguishing	in accord. with UL 492	
Vibration resistance	in accord. with EIA STAND. RS-186-7E	
Tightening torque	3 Nm (M4 terminal screws)	

Total elongation is about 15 mm after the overpressure disconnecter release.  
Don't use rigid connections.



Fixing Stud : M12  
Case materials: Aluminium

Ø (mm)	H (mm)
90 ± 1	370 ± 2

DUCATI energia	CAPACITOR for THREE - PHASE POWER FACTOR CORRECTION	Qn = 30kVAR 760Uac
S.p.A		Part. Number : 216372000

## CHARACTERISTICS

Power	30	kVar
Rated Capacitance	3x165,3	µF
Capacitance Tolerance	-5+5%	
Rated Voltage Un	760	V
Rated frequency	50	Hz
Rated Current (In)	22,8	A
Dielectric	PP film	Self healing
Dielectric losses	< 0.4	W/kVar
Connection	Y	
Overpressure safety device		
Aluminium case		
Impregnant	Castor oil	Non PCB

## Equipment

External discharge resistors	None
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## MAXIMUM RATINGS

Overvoltage	1.1 Un	8 hours/day
	1.15 Un	30min/day
	1.2 Un	5min/200times
	1.3 Un	1min/200times
Overcurrent:	1,3 In	
Inrush current:	300 In	

## TEST DATA

AC Test voltage terminal to terminal	2,15 Un	Vac (2 sec)
AC test voltage terminal to case	6000	Vac (10 sec)

## CLIMATIC CATEGORY

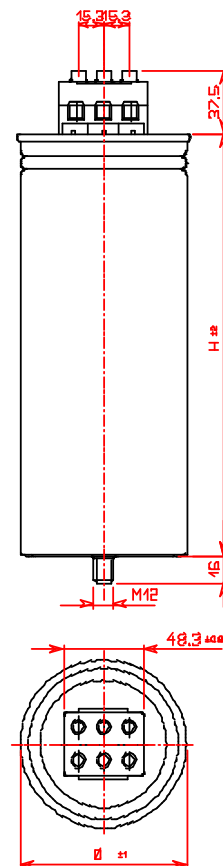
Temperature class (ambient)	-25/D	(max 55°C)
Storage temperature	-55 +70	°C
Altitude maximum	2000m	a.s.l.

Failure quota	300/10E9
Expected life (Ln)	>150000h

<b>Standards:</b>	EN60831-1
	EN60831-2
Degree of protection:	IP20 indoor mounting

Humidity category	in accord. with DIN 40040	F
Self-extinguishing	in accord. with UL 492	
Vibration resistance	in accord. with EIA STAND. RS-186-7E	
Tightening torque	3 Nm (M4 terminal screws)	

Total elongation is about 15 mm after the overpressure disconnecter release.  
Don't use rigid connections.



Fixing Stud : M12  
Case materials: Aluminium

Ø (mm)	H (mm)
85 ± 1	370 ± 2

DUCATI energia	CAPACITOR for THREE - PHASE POWER FACTOR CORRECTION	$Q_n = 25,5\text{kVAR } 800\text{Uac}$
S.p.A		Part. Number : 416372802

## CHARACTERISTICS

Power	25,5	kVar
Rated Capacitance	3x42,3	$\mu\text{F}$
Capacitance Tolerance	-5+10%	
Rated Voltage $U_n$	800	V
Rated frequency	50	Hz
Rated Current ( $I_n$ )	18	A
Dielectric	PP film	Self healing
Dielectric losses	$\leq 0.4$	W/kVar
Connection	D	
Overpressure safety device		
Aluminium case		
Dry type		

## Equipment

Discharge resistors	None
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## MAXIMUM RATINGS

Overvoltage	1,1 $U_n$	8 hours/day
	1,15 $U_n$	30min/day
	1,2 $U_n$	5min/200times
	1,3 $U_n$	1min/200times
Overcurrent:	1,3 $I_n$	
Inrush current:	100 $I_n$	

## TEST DATA

AC Test voltage terminal to terminal	2,15 $U_n$	Vac (2 sec)
AC test voltage terminal to case	6000	Vac (10 sec)

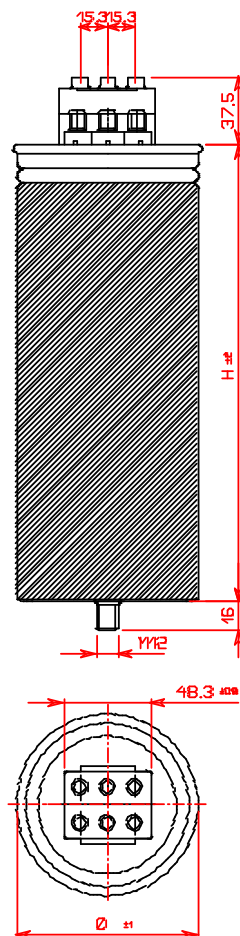
## CLIMATIC CATEGORY

Temperature class	-25/D	(max 55°C)
Storage temperature	-55 +85	°C
Altitude maximum	2000m	a.s.l.

Failure quota	300/10E9
Expected life ( $L_n$ )	>100000h

Standards:	EN60831-1
	EN60831-2
Degree of protection:	IP20 indoor mounting

Humidity category	in accord. with DIN 40040	F
Self-extinguishing	in accord. with UL 492	
Vibration resistance	in accord. with EIA STAND.	
	RS-186-7E	



Fixing Stud : M12  
Case materials: Aluminium

Ø (mm)	H (mm)
100 ± 1	370 ± 2

Total elongation is about 15 mm after the overpressure disconnector release.  
Don't use rigid connections.


**POWER FACTOR CORRECTION CAPACITORS  
TEST CERTIFICATE No.: S 06/03**
**Electrical Test DPT  
Date: 06/02/03**

According to EN 60831-2 specification

TEMPORARY TYPE : 216.37.1900

Rated capacitance : 3 x 165,3  $\mu$ F

Rated Reactive Power : 30 kvar

Quantity No. : 06

Capacit. tolerance : - 5 + 5 %

Rated Voltage : 760 V

Rated Frequency : 50 Hz

Connection : Y

**ROUTINE TEST \_ all serial No. : 06**

\*\*CONSTRUCTION CHECK : by drawing No. : 216.37.1900

\*\*SEALING TEST : at 70 °C for 10 hours

\*\*INTERNAL CONNECTION : STAR

\*\*TEST VOLTAGE : it has been carrying out putting under voltage one terminal and the other two connected in parallel.

 $V_{test} = 1,5 * 2,15 * (V_n/1,73) = 1415 \text{ V } 50 \text{ Hz - duration } 10'' \text{ (sec.)}$ 

\*\*TEST VOLTAGE TERMINALS - CASE = 6 Kv 50 Hz - duration : 60'' (sec.)

\*\*CAPACIT. AND "TAN  $\delta$ " MEASUREMENT : V/FASE = 440 V 50 Hz\*\*EXTERNAL DISCHARGE RESISTANCE : 3 x 120 k $\Omega$  Y CONNECTED 50V/1 min.
**LIST OF CAPACITANCE AND TAN  $\delta$   
VALUES RECORDED DURING TESTING**

Serial No.	CAP.1 ( $\mu$ F)	TAN $\delta$ 1 (x10r-4)	CAP.2 ( $\mu$ F)	TAN $\delta$ 2 (x10r-4)	CAP.3 ( $\mu$ F)	TAN $\delta$ 3 (x10r-4)	$\theta$ (°C)
1	168,79	3,66	168,62	3,64	169,25	3,66	22
2	169,06	4,24	168,83	4,14	168,61	4,06	22
3	168,43	3,82	168,85	3,58	168,61	3,74	22
4	168,30	3,94	168,89	4,24	169,47	4,22	22
5	168,66	3,88	168,69	3,98	168,20	4,08	22
6	168,84	4,52	168,70	4,30	168,45	4,02	22