AFRICAN CAPACITORS (PTY) LTD

MOTOR START

&

RUN CAPACITORS

Metallized polypropylene film capacitors for motor running applications

Description

Metallized polypropylene dry capacitors produced by African Capacitors offers high electrical characteristics as well as quality and reliability. The dielectric is a thin layer of low-losses polypropylene film on which the electrode is deposited by vacuum evaporation.
This technology gives the capacitors self-healing capability when a short-circuit occurs in any point of the dielectric.
The healing process, lasting a few microseconds, involves an amount of charges of some nano Coulombs and fully restores the efficiency of the capacitor. The high electrical characteristics of the polypropylene film and the manufacturing technology permit the manufacturer to produce capacitors with light weight, very small sizes and a high stability of the capacitance versus time. Capacitors are PCB free.

Construction

The capacitive element, made of wound layers of metallized polypropylene (dielectric), is housed in a cylindrical can with or without central fixing screw. The terminations can be either Quick-Connect type or cable.

The element is locked inside the can by a suitable sealing material.

Cans are made of suitable plastic.

The sealing lids and the supporting terminals are made of plastic material.

The plastic materials are self-extinguishing, Class V1 according to UL-94 Standards.

Capacitors with protection degree IP66 and cable outlets are sealed with epoxy resin.

Applications

These capacitors are designed for general A.C. applications and particularly for:
- starting and running of mono-phase induction motors.
- single-phase supply of three-phase asynchronous motors.
- series and parallel power factor correction of fluorescent and discharge lamps.

Nominal characteristics

Rated voltage Vn: it is the r.m.s. value of the sinusoidal A.C. voltage applicable to the capacitor over the working temperature range and for which the capacitor has been designed.

Rated current In: it is the r.m.s. value of the current flowing through the capacitor when the rated voltage Vn and the rated frequency fn is applied.

Overloads: the capacitor can work with the following overloads over the permitted temperature range:
- *maximum* voltage: 1,1 Vn
- *maximum* current: 1,3 In the presence of overloads produced will result in a reduction of the life of the capacitors.

Rated frequency fn: capacitors are designed for a frequency range between 50 and 60 Hz. Higher frequencies are permitted with a proper voltage derating.

Temperature range: temperatures are measured on the surface of the capacitor:
- minimum temperature: -25°C
- maximum temperature: +70°C or +85°C (hottest-spot)

Storage temperature: -40°C - +85°C

Losses (tgδ): <0,1% at 50 Hz.

Capacitance tolerance: nominal tolerance ±5%. Different tolerances can be provided on request.

Pulse rise time dv/dt: the maximum permitted value is 20V/ μ sec.

Short-time over voltages resistance: the self-healing characteristics, gives the motorrun capacitors a considerable strength to the transient over-voltages. They can stand short over-voltage up to peak values of 3 Vn.

Tracking currents resistance (DIN 53480): on the plastic materials supporting terminals: KB175.

Tests: the A.C. test voltages at 50 Hz for 2 sec, are, according to SABS 1353-1982 and VDE 560-8 Standards, the following:
- terminal to terminal (DB) at 2,15 x Vn (AB) at l,4x Vn
- terminals to case (DB) (AB) at 3 Kv

During the tests self-healing discharges are admitted.

DC current: capacitors can be used in D.C. current; the relevant values for our standard series are shown in the table 1.

D.C. Rated Voltage	600V
Non repet. peak	800V
dv/dt	20 V/μS

Self-discharge time: RC≥3000 sec.

Protection degree: IP 00.

Capacitors with cables have IP 66 degree.

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Definitions

The service on motors is defined, according to SABS 1353 - 1982 and VDE 0560-8 par. 15, as follows;

Continuous service «DB»

The capacitor remain energised for a period of time much longer than the one necessary to reach the thermal equilibrium.

Intermittent service «AB»

Periods of operation are alternating with no voltage applied periods. The relative operation time «ED» is defined in percentage as the ratio between working time and the total cycle duration «SD».
Ex: AB 25% ED - SD 24h.
This capacitor is for an intermittent service with a cycle duration of 24h of which 6h with the voltage applied and 18h without voltage.

Climatic category and reference reliability (DIN 40040)
According to DIN 40040 standard, climatic categories and reference reliability are defined by five letters with the relevant meanings listed in the tab. 2.

Table **2**

1st Code letter		2nd Code letter		3rd Code letter			4th Code letter		5th Code letter	
Lower Temperature Limit		Upper Temperature Limit (1)		Limits of the relative Humidity %			Failure quotient Failure per 10^9 components hours		Duration of stress in hours (4)	
	°C		°C		Average	Max		pcs		hours
G	-40	S	70		(2)	(3)	M	1000	S	30000
H	-25	R	75	F	<75	<95	N	3000	T	10000
J	-10	P	85				P	10000	U	3000
K	0	M	100				Q	30000	V	1000

(1) measured on the surface of the capacitor
(2) yearly average value.
(3) *maximum* value for no longer than 30 days a year During the remaining days it is occasionally permitted a value of no more than 85%.
(4) life duration at the rated voltage and maximum temperature with a failure rate started by the 4th letter (Ex.: MS - Expected life 30 000 hours and failure rate ≤3%).

Mechanical characteristics

Vibrations:
Capacitors conforms to DIN 40046 and IEC 68 - 2 - 6 standards under the following test conditions:
- frequency range: 10-55 Hz
- stress: 10 g
- duration: 6 h
- variation: logarithmic or linear

Fixing:
Capacitors may be provided of a M8 or M12 fixing stud.
- 3,5 Nm torque for the plastic bolt.
- 6 Nm torque for the aluminium bolt.

Marking:

Data shown on the capacitors are the following:

- mark, series, capacitance and relevant tolerance, frequency, rated voltage and relevant reference reliability, climate category (according to DIN 40040), temperature range, symbol of the discharge resistor if it is foreseen, international approvals marks, code of the manufacturing date. Reference SABS 1353-1982.

Quality

The uniformity and consistency of the quality of African Capacitors products is assured by the checks made on 100% of the finished products, by the quality control made on all the working stages and by life tests made on samples from the production.

Mounting considerations

Capacitors can be mounted in any direction.
Apart from their resistance to vibrations, it would be better to mount them away from those parts subject to intensive vibrations; this is to avoid any undue stress.
Take care not to mount the capacitor in areas close to devices radiating a strong heat.
The temperature on the surface of the capacitor cannot exceed, even under the worst conditions, the maximum permitted temperature. It is advisable to make an experimental measurement of the temperature reached by the capacitor under the working conditions in the final application and after the thermal equilibrium has been achieved.

Remarks on the expected life duration

The precise knowledge of the expected duration of the life of a capacitor, under certain working conditions, permits its correct use on the designated application.

The life of a capacitor depends on the working voltage and the temperature according to well defined laws.

Voltage: (with constant temperature)

$$\left(\frac{Vo}{Vn}\right)^{-n} = \frac{Lo}{Ln}$$

Ln = expected life at the rated voltage Vn
Lo = expected life at the working voltage Vo
n = experimental value (about 7-10)

Temperature: (with constant voltage)

The temperature influences the life of the capacitor as it favours the chemical reactions that are responsible for the dielectric aging.
It may be considered that each 10°C rise of the working temperature causes a 50% reduction of the capacitor life. Usually the following formula is adopted:

$$L(tx) = L(tn).2^{\frac{(tx - tn)}{10}}$$

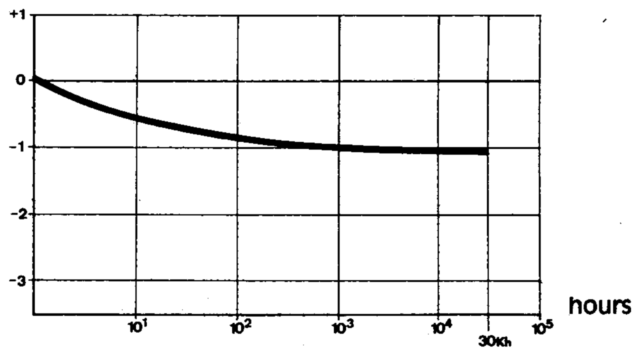
where: L(tx) is the capacitor life at temperature tx.
L(tn) is the capacitor life at the maximum rated temperature.

1 Technical information

1.1 Capacitance stability

The present technology offers such a high stability of the capacitance versus time that the decrease of the capacitance in the expected life of the capacitor under normal conditions is about 1% with a maximum of less than 3% as requested by the norms. As the average capacitance from the production is normally higher than the nominal capacitance, it can still be expected to be within tolerance at the end of the expected life.
Figure 2 represents the typical trend of the capacitance versus time.

Figure 2
AC/C%



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1.2 Capacitance
The capacitance of capacitors with polypropylene dielectric has negligeable variations either versus the temperature or the applied voltage.

Figure 3 and Figure 4 show respectively the typical trends for the above mentioned series.

Figure 3

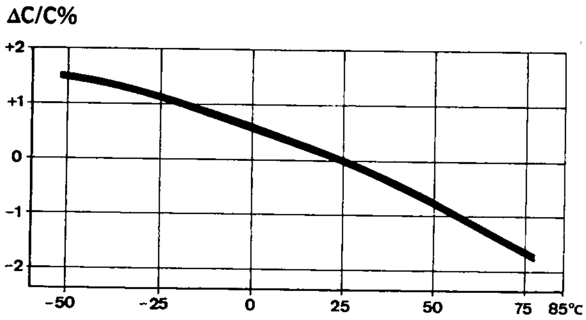
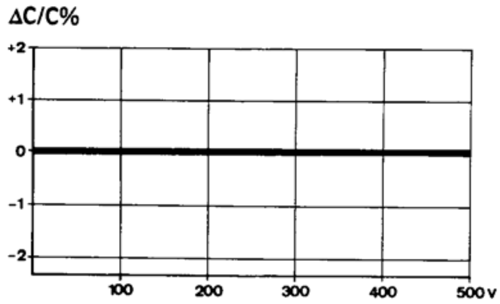


Figure 4

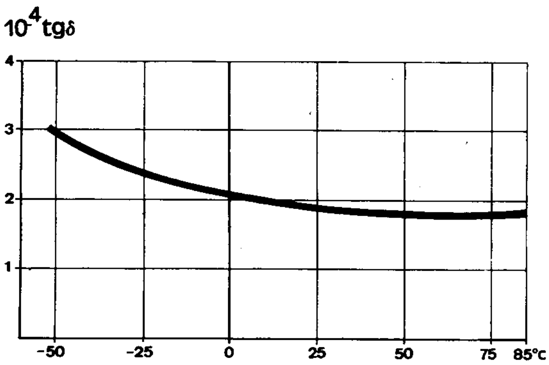


1.3 Loss angle
The losses of the capacitor are defined as the tangent of the angle δ between Xc and Zc of the capacitor and therefore from the ratio Rc/Xc (ratio W/var).

Rc represents the losses in the dielectric, in the electrodes and in the inner connections of the capacitor.

Figure 5 and Figure 6 show the typical trends versus the temperature and the frequency.

Figure 5



1.4 Insulation resistance
The value of the insulation resistance *is* not usually given. It is the given time constant of the capacitor τ = RxC, that represents a constant, in seconds (or MΩ x µF), independent from the capacitance. The real insulation resistance can be obtained from the abovementioned formula.
Figure 7 shows the typical polypropylene trend of the constant τ versus the temperature.

Figure 6

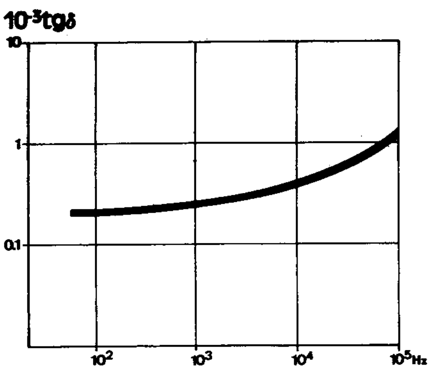
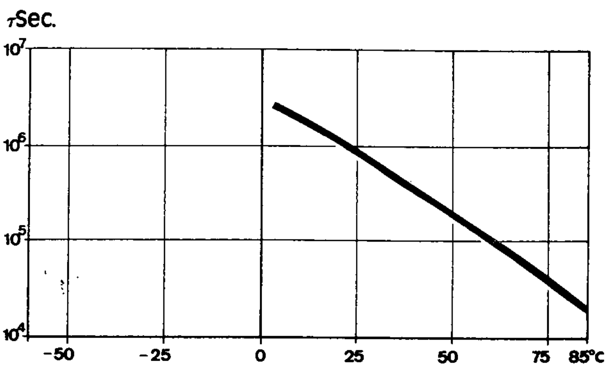


Figure 7



2 Applications

2.1 Mono-phase induction motors

A capacitor applied to a mono-phase induction motor improves its performance by generating or reinforcing the rotating field.
Motors of this kind are made with two stator windings; one of them is the auxiliary and is fed by a suitable capacitor (Figure 8).
The capacitor increases either the starting torque and the full load power as the current flowing through the auxiliary winding, de-phased by the capacitor, creates a rotating field.
It has to be considered, in the case of the applicable capacitor, the voltage across it is usually higher than the mains supply.
The choice of the capacitance is usually empirically made on the motor. This is because of suttle differences between different motor manufacturers.
As the torque and the power of the motor also depends on the reactive power of the capacitor, the power can be calculated with the following formula.

$$Qc = 2\pi.f.C.10^{-6}.Vc^2(var)$$

Vc = motor working voltage

Figure 8

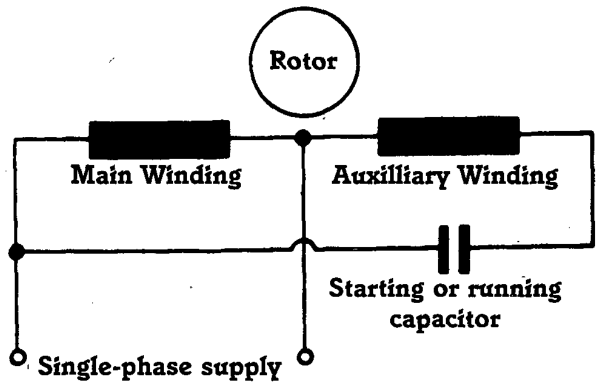
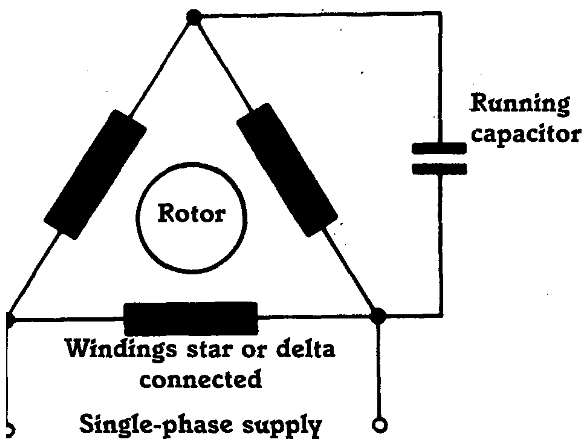


Figure 9



2.1.1 Starting capacitor

A high starting torque is required by the motor, in this case a high capacitance capacitor is used. A centrifugal switch generally disconnects this when approximately half the speed is reached. This is to avoid overloads of the auxiliary winding.
The capacitor remains energised for very short periods therefore it will have sizes smaller than a running capacitor with the same capacitance.
It is possible in this way to get starting torque's about equal to double of the nominal requirements.
The capacitance has to be such as to provide a reactive power about double of the nominal power of the motor with a Vc voltage.

2.1.2 Running capacitor

After the initial start of the motor this capacitor is also needed to obtain the full load power of the motor where it then remains in continuous operation with the motor, thus forming an integral part of this circuit.
The voltage Vc is about 1,5-2 times the mains supply and decrease with the increase of the load.
With capacitive reactive power of about 75% of the nominal power of the motor, the comparison of power is slightly lower than that of a three-phase motor of equal size.

2.1.3 Starting and running capacitor

Where both characteristics mentioned above are required by the motor design.
It will therefore be equipped with a starting capacitor of a high capacitance which is disconnected once the speed has increased and with a running capacitor to remain in the circuit.

2.2 Three-phase asynchronous motors

It is possible to connect a three-phase motor to a single-phase power line, using a capacitor of an appropriate capacitance.
The capacitor will be connected as shown in Figure 9.
With a capacitance of about 70µF/KW at 220 V it is possible to get a starting torque of about 1/4 of the nominal one, while the rated power will be about 3/4 of the nominal one.
It is often necessary to increase the starting torque by also adding a starting capacitor that is disconnected once the motor is running.
It is possible to reverse the rotation of the motor by connecting the capacitor to the other mains of the three-phase supply.
The voltage on the capacitor, in steady conditions, is about 15% higher than the mains supply-

Plastic Case

Applications
General purpose A.C. capacitors for motor run applications.

General characteristics
- Capacitive elements are wound on high speed automated machines, in cylindrical shape, non inductive, self-healing, surge proof with low loss metallised polypropylene plastic film.
- Filled with self-extinguishing resin **(NO P.C.B).**

Technical data		
Series MKP		
Reference Standards SABS 1353 - 1982 VDE 0560-8; IEC		
Application class (DIN 40040) See table		
Operating temperature range (case)	-25 to +70°C	
Storage temperature	-40 to +85°C	
Rated D.C. Voltage	630V	
Peak non repetitive D.C. voltage	800V	
Voltage rise/fall time (dv/dt) max	20V/u.sec.	
Test voltage terminal to terminal	1,5 Un	
Test voltage terminal to case	3KV 50 Hz. 1 minute according to VDE 0560-8	
Case	Self extinguishing plastic case and sealing cover according to IEC 707 and UL 94 standard Grade V1	
Terminals	Single 2,8 *mm* or 6,35 *mm* tags, double 6,35 *mm* tags, 0,8 mm thick. Cabtyre cable with top or side entry	
Creepage distance		$\geq$ 7 mm
Clearance in air		$\geq$5 mm
Permissible relative humidity	Annual average $\leq$ 75% at 24°C on 30 days/year. continuously $\leq$ 95% on other days. Dewing not admissible.	
Self discharge time		RC $\geq$ 3000 s
Degree of protection	IPOO	IP30 with plastic cap
Dissipation factor	20 x 10^4, over 30µF $\leq$50 x 10^{-4} at 20°C and 50 Hz	
Vibration strength	DIN 40040, Table 6 Class U	
Fixing torque max	M8 Stud driving torque 6Nm for aluminium	3,5 Nm for plastic

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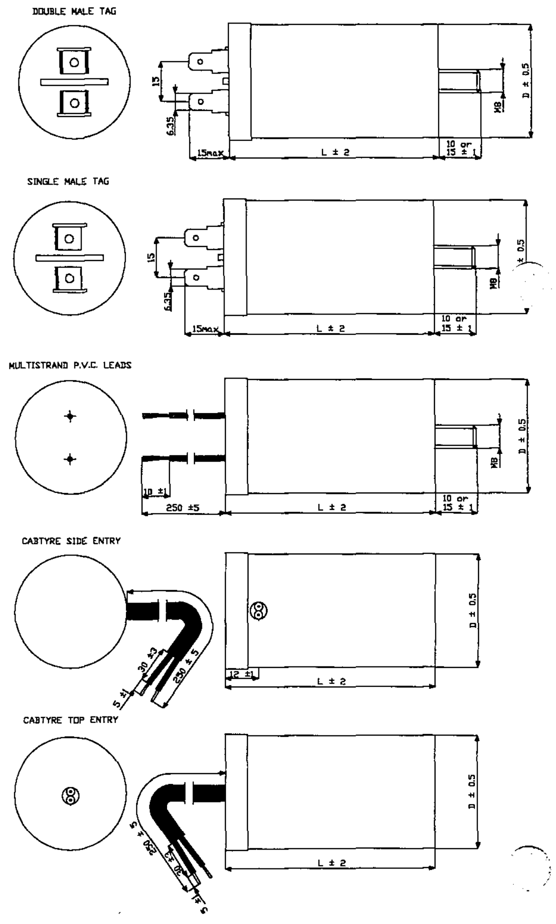
Product range for motor run applications

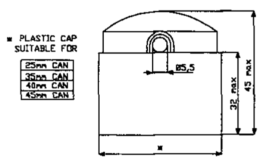
Plastic case

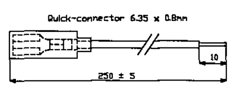
	High duty cycle standard		Low duty cycle optional		
HPF/MS 30 000 hours	400V-				
HPF/NT 10 000 hours	440V-		380V-		
HPF/PU 3 000 hours	500V-		400V-		
HPF/QV 1000 hours			440V-		
Rated Capacitance (µ F)	Dimensions (mm)		SABS 1353-1982	IEC	VDE O56O-8
	D±0,5	L±2			
1,5	25	55	0	A	A
2	25	55	0	A	A
2,5	25	55	0	A	A
3	35	55	0	A	A
3,5	35	55	0	A	A
4	35	55	0	A	A
5	35	55	0	A	A
6	35	55	0	A	A
7	35	73	0	A	A
8	35	73	0	A	A
9	40	73	0	A	A
10	40	73	0	A	A
12	40	73	0	A	A
14	40	73	0	A	A
15	40	73	0	A	A
16	45	73	0	A	A
18	45	93	0	A	A
20	45	93	0	A	A
22	45	93	0	A	A
25	45	93	0	A	A
30	45	93	0	A	A
32	45	93	0	A	A
35	45	128	0	A	A
40	50	128	0	A	A
45	50	128	0	A	A
50	50	128	0	A	A

Typical dimension shown; Other dimension upon request
0 Approval ***A*** Approval pending



All versions available with or without mounting stud





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Starting arrangements for single-phase motors

General information:-

It is not always realised that a true, pure single-phase induction motor would be impossible to start. The inherent characteristics of the motor and its single-phase windings mean that the rotor does not know which way to rotate when the winding is energised. Hence, the single-phase motor requires a second phase to start it. This second phase is commonly produced by an auxiliary or starting winding which produces a second phase artificially by means of a phase-splitting device. In this article, AFCAP presents some of the techniques for getting the rotor to rotate.

Split-phase motors

The phase-splitting device can be simply resistive by making the auxiliary winding out of much thinner wire than the main winding and therefore of a higher resistance (see figure 1). This, in effect keeps it more in phase with the a.c. supply *than is* the main winding. The resultant small phase shift (around 30°) gives a sufficient starting torque for light loads such as fans, where the initial inertia is low.

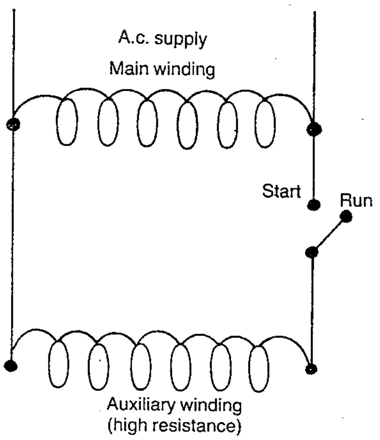


Figure 1. Split-phase motor.

This arrangement takes a very heavy starting current, typically seven to eight times normal running value. It also requires the auxiliary winding to be switched out immediately after starting, to prevent overheating. It can however, be used for many intermittent duties, such as small drills, lathes and food-mixers, where full speed can be reached quickly. Motors using this technique are called split-phase motors.

Capacitor motors

A much higher starting torque can be produced by installing a capacitor in the auxiliary winding instead of resistance. A capacitor in series with this winding will cause the current to be up to 90° in advance of that in the main winding. This enables motors to be produced which can operate from start against a heavy inertia, for example driving a refrigerator compressor. These motors also draw less starting current (around 4 to 4,5 times full load

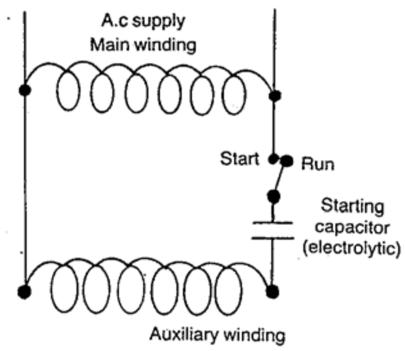


Figure 2. Capacitor motor with a starting capacitor (electrolytic).

value) than resistive split-phase arrangements.

Starting capacitors (electrolytics) To produce a strong starting torque, large capacitance values may be necessary. This could mean large and expensive capacitors. Furthermore, although a large capacitor may be the correct value for starting the motor, it will be poorly matched to the motor once full speed is reached. Both these difficulties are resolved by using a special type of electrolytic capacitor in conjunction with an automatic cut-out device (see figure 2). Electrolytic capacitors provide a large capacitance in a small space at low cost. Although electrolytic capacitors are essentially d.c. devices, a special type is used for motor-starting. These special capacitors

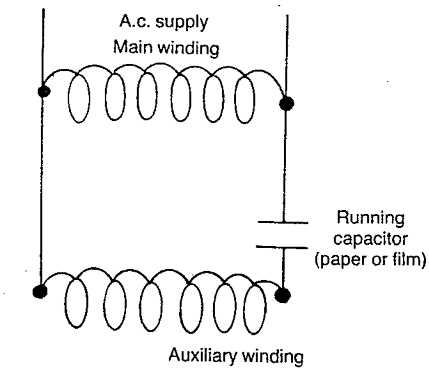


Figure 3. Capacitor motor with a running capacitor (paper or film).

will withstand a.c. for a few seconds providing they are not called upon to do this more than 20 times within an hour. These electrolytic motor-starting capacitors are entirely unsuitable for use with a.c. except strictly on an intermittent basis: they must be switched out of circuit after a maximum of three seconds.

They are only used on single-phase a.c. motors which are provided with a centrifugal switch, or other device which cuts the capacitor out of circuit immediately after starting.

Selection

To obtain the correct starting torque, the correct capacitance value must be selected. This is basically a question of motor design: there is no straightforward regular relationship between capacitance and the motor size in kW.

When replacing these capacitors, the capacitance value and voltage should be taken from the manufacturer's plate on the motor or from the old capacitor.

Voltages and capacitance For most practical purposes, the electrolytic starting capacitors used in South Africa fall into three voltage divisions:

Low voltage

110/125 V a.c. supply voltage 150 V r.m.s. max capacitor voltage (see Table 1).

This range is moderately common in South Africa. Although these capacitors can be used on motors operating directly from a 110/125 V a.c. supply, they are also sometimes used across half of the main winding only, in dual voltage motors (see Figures 5 and 5a). In such instances the supply may be 220/250 V a.c., but the capacitors will only see 100/125 V a.c. The capacitance range extends from about 21/25 µF to say 1 000/1 200 pF.

Medium voltage

220/250 V a.c. supply voltage. 275 V r.m.s. max capacitor voltage (see Table 2).

This range is the most common in South Africa. The capacitance range is normally from about 20/30 µF to around 200/250 µ F.

High voltage

280 V a.c. supply voltage. 350 V r.rn.s. max capacitor voltage (see Table 3).

Although capacitors in this range are manufactured overseas; they are uncommon in South Africa. This range normally begins at say 21/25 µF but terminates at around 145/174 µF *maximum.*

Storage and reforming
These capacitors contain a small amount of moisture. For reasons of safety they are not hermetically sealed, but, on the contrary, normally incorporate a safety vent via which the capacitor contents may be expelled on overstress. They therefore have a limited shelf life depending on the storage temperature. Well made capacitors can typically have a shelf-life in excess of five years when the storage temperature does not exceed 40°C. Starting capacitors which have not been used for, say, over a year should normally be tested before placing them in service. If any deterioration is suspected, the capacitors should be 'reformed'.

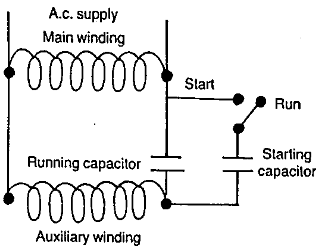


Figure 4. Capacitor motor with both a starting capacitor and a running capacitor.

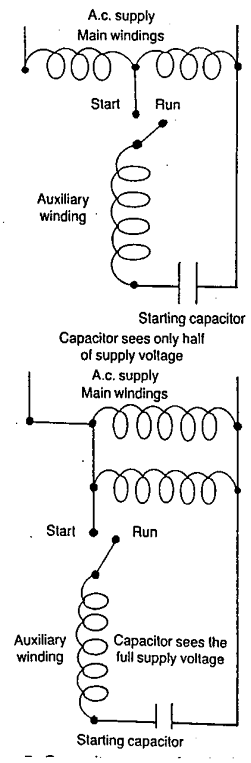


Figure 5. Capacitor motor for dual voltage operation.
a) Main windings in series (for operation from 220/250 Va.c. supply).
b) Main windings in series (for operatin from 110/125 V a.c. supply).

This can be done by applying the mains voltage to the capacitor for a second or so at a time, repeating at intervals up to a maximum of ten times. In the case of capacitors already installed on motors, the motor should be released from load and then switched on several times. The main voltage in all cases, should not exceed the rated voltage of the capacitors. The deterioration of these capacitors when not in use, does not follow any clear linear law. In general, under typical South African conditions they appear to have a very fair shelf-life, although it can be anticipated that at least a few out of any batch will break down if not 'reformed' after a few years.

Running capacitors (non-electrolytic). In certain applications a lower starting torque is acceptable. In these cases a small capacitor can be considered as a phase-shifting device. This smaller capacitor need not be an electrolytic type and can be of paper or metallised-film construction which can be left permanently in circuit (see Figure 3), dispensing with the centrifugal switch or other 'cut-out' arrangement. This arrangement not only provides some capacity to assist motor-starting, but improves the motor power factor and the running characteristics. However, because the capacitor must withstand a.c. continuously, it tends to be large physically, despite the limited capacitance. These capacitors are always described as 'running capacitors'.

Selection
Once again, this is a matter for the designer: the user must adhere to the capacitor parameters shown on the motor nameplate or on the capacitor being replaced. The choice of a running capacitor is even more limited than with a starting capacitor:

Capacitance
This must be correct within ±5% and is sometimes stipulated down to a fraction of a µF (e.g. 6,8 µ F*)*.

Voltage
This is almost always above that of the mains voltage (e.g. a motor operating from a 250 V a.c. mains supply will normally take a running capacitor rated at 380/440 V a.c. continuous). A 440 V a.c. capacitor should always be used unless there are positive indications that a lower voltage is permissible.

Motors using both starting and fanning capacitors.
Motors may be fitted with starting capacitors only or running capacitors only, depending on type of duty which faces the motor. Alternatively, the motor may *be* fitted with both a starting and also a running capacitor.

This gives the advantages of both worlds: i.e. the motor now has a maximum starting torque plus the advantage of an improved power factor and running characteristics whilst running on full load (see Figure 4).

Table 4 shows the various types and values of capacitors over a complete range of small single-phase 200/250 V a.c. motors manufactured by a large international company. It will be noted that motors with similar parameters do not always use similar capacitors. The capacitor values shown are those selected by the designer for this particular range of motors: these may or may not apply to other ranges or to similar motors made by another manufacturer.

Some typical values:-

Motor Starting Capacitors (electrolytic) This information is given as a general indication only, without commitment. The specific capacitance and voltage should be taken from the motor name plate or from the capacitor being replaced.

Table 1. Low voltage
110/125 V a.c. supply voltage 150 V r.m.s. max capacitor voltage.

Motor size	Typical capacitor value
kW	µ F
0,093	100/130
0,124	120/150
0,186	160/200
0,249	240/230
0,373	320/400
0,560	400/500
0,746	500/580

Table 2. Medium voltage
200/250 V a.c. supply voltage 275 V max capacitor voltage

Motor size	Typical capacitor value
kW	µ F
0,093	20/30
0,124	30/40
0,185	40/70
0,249	60/80
0,373	80/110
0,560	108/140
0,746	138/182

Table 3. High voltage 280 V a.c. supply voltage 350 V r.m.s. max capacitor voltage

Motor size	Typical capacitor value
kW	µF
0,093	26/37
0,124	37/51
0,186	51/68
0,249	68/90
0,373	90/115
0,560	105/130
0,746	130/165

Electrolytic motor start capacitors

Description

The Afcap motor starting capacitors are non-polarised aluminium electrolytic capacitors for a.c. applications. To start a.c. single phase motors. These capacitors are for intermittent working only with a maximum duty cycle of typically 20 starts, each of 3 seconds duration, per one hour. These capacitors must be switched out of circuit by a centrifugal switch, or other devices, immediately after starting the motor.

Construction

The capacitive element, made of wound layers of aluminium foil and craft paper is housed in a cylindrical can.
The terminations can be either quick-connect type or cable.

- The element is locked inside the can by a suitable sealing material
- Cans are made of a suitable plastic
- The sealing LIDS incorporating a pressure vent supporting the terminals are made of plastic material The plastic materials are self-extinguishing and according to UL-94 Standards. V1

Mechanical characteristics

Vibrations:

Reference Standards Din 40046 and IEC 68-2

- Frequency range: 10 - 55 Hz
- Stress: 10 g
- Duration: 6 h
- Variation: Logarithmic or linear

Fixing:

- Normally by enclosure or fixing clamp

Marking:

Data shown on the capacitors are the following:

- Logo, series, capacitance and relevant tolerance, frequency, rated voltage and temperature range, symbol of the discharge resistor if fitted, appropriate approval marks and the code of manufacturing date.

Quality:

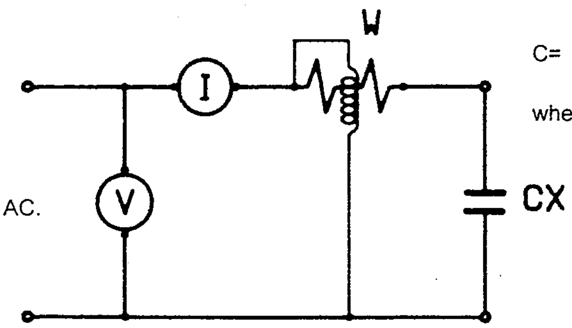
The uniformity and consistency of the quality of African Capacitors products is assured by the checks made on 100% of the finished products, by the quality control checks made on all the working stages and by life tests made on samples from the production.

Technical characteristics and measurements

Using the circuit shown in Fig. 1, apply rated voltage to the capacitor and measure current and dissipated power. Current will be measured after 2 - 3 seconds, dissipated power within 3 seconds after application of rated voltage. Capacitance and power factor must be calculated with the following formula:

Fig. 1

50÷ 60 Hz AC.



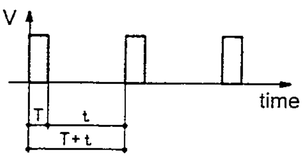
$$C = \frac{I \cdot 10^6}{2 \cdot \pi \cdot f \cdot V} \qquad PF\% = \frac{W \cdot 100}{V \cdot I}$$

where:
- C = capacitance in µF
- I = current in amperes
- π = constant 3.14
- f = frequency in hertz
- V = applied voltage
- PF = power factor
- W = dissipated power in Watts

Note: To have accurate measurements one requires special types of instruments

Other characteristics

Please, inquire for information about different duty cycles or particular applications.

Technical characteristics			
Reference standard		VDE 560-8 / ASE 1029 / IEC 252	
Working voltage	Vn	rms voltage that can be applied to the motor-starting capacitor in conformity with the specified duty cycle.	
Rated frequency	Hz	50 ÷ 60	
Cycle Characteristics	N T t NT $\frac{T}{T+t}$ %	number of starts/hour start-up time time Vn off starter rating/hour duty cycle	

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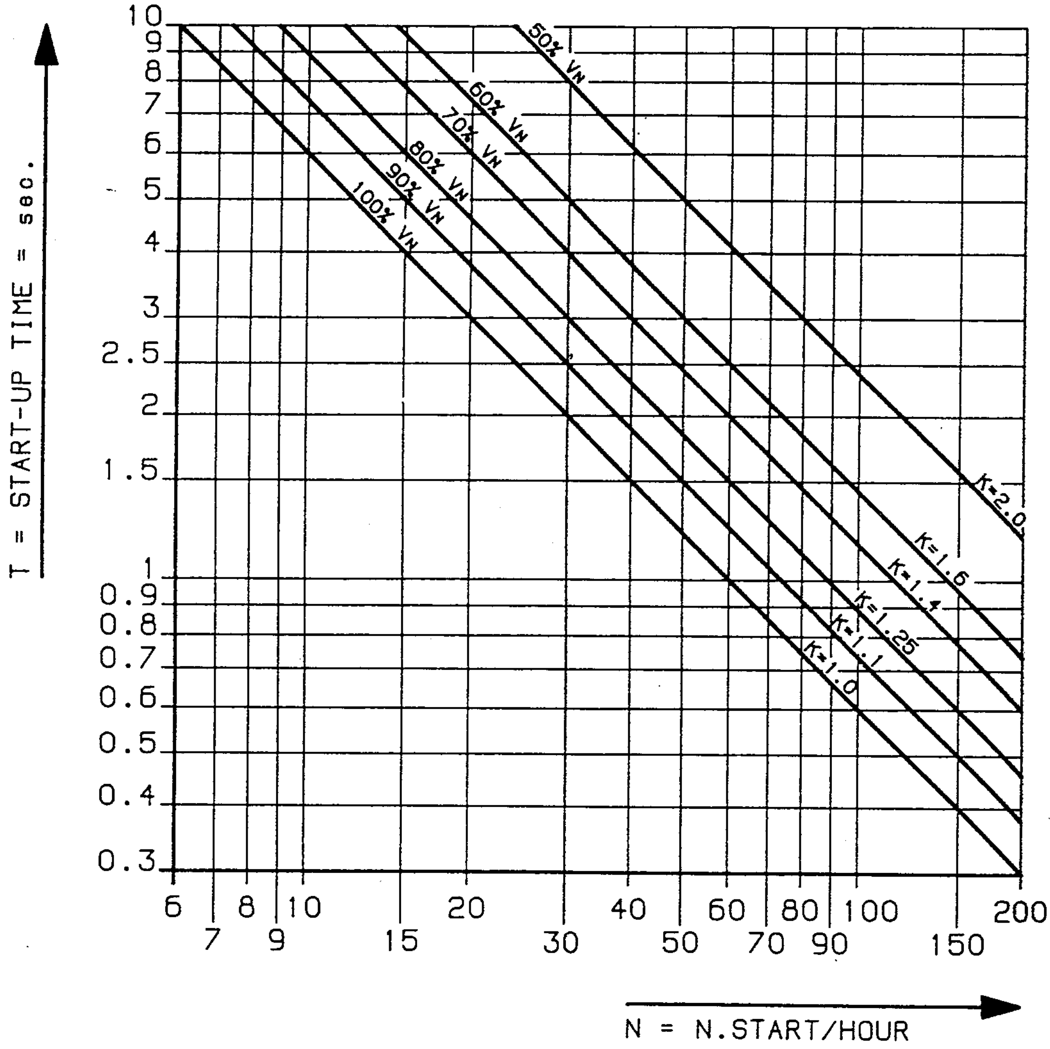
Type		**Standard Applications**	
Max working voltage (1/10 max. of the start period)	Vg	1.2 Vn	
Climatic category		up to 260 Vac - 10/ +60/ F=JUF (DIN 40040) 280 ÷330 Vac - 10/ +55/ F=JVF (DIN40040)	
Capacitance tolerance	%	see table; ± 10% on request	
Power factor:			
Typical value	%	8%	
Max. value	%	12%	
Cycle characteristics:	Vn	124÷ 330 V a.c.	
	°C	60°C	40°C
	NT	(*)60	80
Max. start-up time = (S)	N	6	8
	T	(10)	(10)
	t	590	350
		1.7%	2.8%
	Note	Different cycles are possible with the limits of the indicated NT and T max.; for ex. (*): NT= 60 could also represent N= 10 / T=6 or N=20 / T=3 etc.	
Stability test:	°C	The max temperature in conformity with the specified climatic category.	
	NT	60	
8h. at 1.2 Vn	N	20	
According to vide 560-8	T	3s	
	t	177s	
	$\frac{T}{T+t}$ %	1.7%	
Rapid test	°C	25°C	
	NT	120	
	N	60	
	T	2	
6h. at Vn	t	58	
	$\frac{T}{T+t}$ %	3.3%	
Expected life:	°C	~ 40 °C	
	NT	30	
No. of starts up		> 100.000	
Storage test	h	l00h	at 85 °C

Working voltage depending on the starter rating NT

• Standard use at rated V. with NT=60 (N=20 starts/hour and T=3" of start-up time). At the rated V., N and T can change on the line VN=100% in conformity with the max values of start-up time indicated in the data sheet-TABLE 2.

• For heavier cycles NT>60, the allowed working V. is lower than the rated V. of the % indicated on the lines in conformity with the required NT (es.: a 260VN capacitor with a NT= 120 can work at a W.V=260x0.7 = 182 Vac).

• The indicated values K represent the multiplicative coefficient that, according to the wished NT and the real working voltage, give us the possibility to find out the rated voltage of the capacitor (es.: an appliance at W.V=220 VN with NT=90 needs using of capacitor at working V=220xl.25 = 275 Vac).



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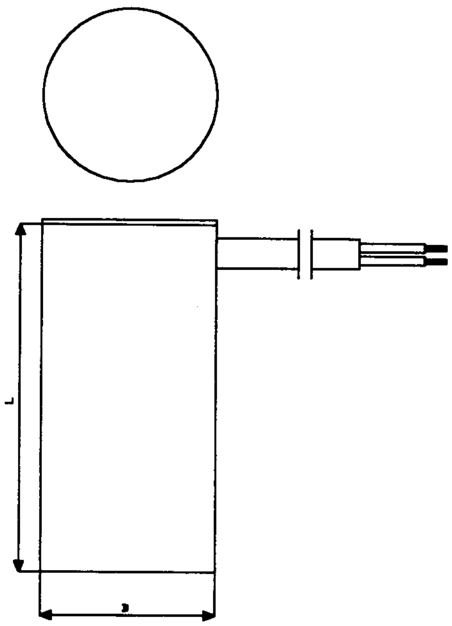
Product range for motorstart applications

Rated Capacitance (µ F)	Dimension (mm)	
	D±l	L±2
20-30	40	80
30-40	40	80
40- 50	40	80
50-65	40	80
65-80	40	80
80 -100	40	80
100 -125	40	80
125 -160	40	80
125 -160	40	114
160 - 200	40	80
160 - 200	40	114
200 - 250	40	114
250 - 300	40	114

Plastic case

Typical dimensions shown other dimensions upon request

CAPTYRE SIDE ENTRY



SINGLE MALE TAG