

# CHARGE

May 2022

A Technical News Journal from Deki Electronics Ltd

## THE ONLY CONSTANT IS CHANGE

We have a change of guard at the Editor's Desk. Our erstwhile editor, Mr Anil Bali, has retired from Deki after a long innings at the helm. We wish him all the best and welcome Mr P Shanker Raj as the new editor. Shanker, as he is known in the industry, is well suited to take on the additional responsibility and continue the good work begun by Mr Bali.

### Editor's Desk

Dear Reader,

Deki is India's largest manufacturer of plastic film capacitors and a leading supplier of film capacitors for lighting, fan regulators, energy metres and automotive applications.

When it comes to capacitive type fan regulators, we have learned a lot in the last ten years while designing, manufacturing and supplying AC film capacitors for this very application.

We have understood that film capacitors used in capacitive type fan regulator need to deliver more as compared to other AC film capacitors because of the compact size requirement.

With that enriched experience we have designed and developed a complete range of film capacitors for motor-run applications specially for fan motors (ceiling, table and exhaust fans).

In this issue of Charge we pick motor run capacitors used in fan motors for a detailed look. You are sure to find it of great use.

As always, we look forward to your suggestions to improve Charge further.

*Shanker Raj*



## We Have Doubled!

As difficulties come, COVID-19 has been of an unprecedented level. Out of the blue we have had to change the way we work and live and planning for the future has been fraught with uncertainty.

However, COVID-19 gave us the time to pause and reflect and, as you know, the outcome was the decision to expand our manufacturing. Thanks to the policies put in place by the Indian government that gave us the belief to make the leap of faith.

We are happy to announce that we have now implemented the planned expansion of our non-inductive capacitor line. Our capacity has doubled and we are ready to serve our customers with renewed vigour and vitality.



## The New Box Line Unboxed

Well, this is almost like a puzzle. While our capacity has doubled after our recent expansion, you will be happy to learn that our box capacitor line has tripled. Now, while you figure out the mathematics, let us share the benefits that our customers will enjoy:

**Shorter lead times.** We shall be able to deliver faster because we are producing faster.

**Import substitution.** No need to import film box capacitors when they are being produced in India itself. Imagine the benefits that accrue from this one, single fact.

**Increased availability of UL and ENEC approved X2 range of capacitors.** Do we really need to outline the advantage in this case? Surely not.

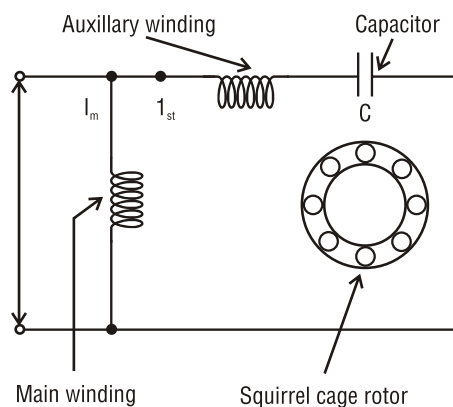


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## Motor Run Capacitor

Electric motors are the most widespread devices in use today, and they are found in practically every appliance. Single-phase induction motors are straightforward, durable, and dependable. They are widely utilized, particularly in household and commercial applications. One of these applications is found as motors in fans.

Single phase motors are not a self-starting motor because single phase power supply cannot create rotating magnetic field because of its nature (only one phase). To rotate the single phase motor we have to provide a rotating magnetic field to the rotor. It is done but adding extra starting winding called auxiliary winding. And a capacitor is connected in the series with this winding because in capacitor voltage lags the current by 90°. So with the help of this capacitor the supply voltage will be phase shifted by 90°. And two phases from single phase supply are achieved simultaneously which makes the motor rotating.



Fan Motor Run Capacitor is the capacitor pictured above. These capacitors are designed for continuous duty, and remain powered whenever the motor is powered, which is why electrolytic capacitors are avoided, and low-loss polypropylene are used instead. The capacitance value of run capacitors for ceiling fan and exhaust fan is usually in the range of 0.68  $\mu\text{F}$  to 4.0  $\mu\text{F}$ .

In the field of motor run capacitors, Deki team interacted with the many fan manufacturers and tried to understand their pain points and challenges that they are facing with respect to capacitors.

**The major problems reported by almost all fan manufacturers are:**

- Drop in capacitance value leading to reduction in fan speed and difficulty in starting the fan.
- Capacitor burst leading to functional failure of fan and risk of fire.

**REASONS:** The major reason for drop in capacitance value is due to excessive self-healing during working life of capacitor and capacitor burst is due to dielectric failure.

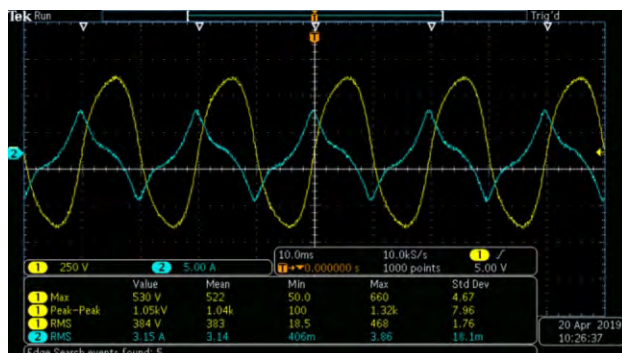


Fig. 1 – Waveform at 230V

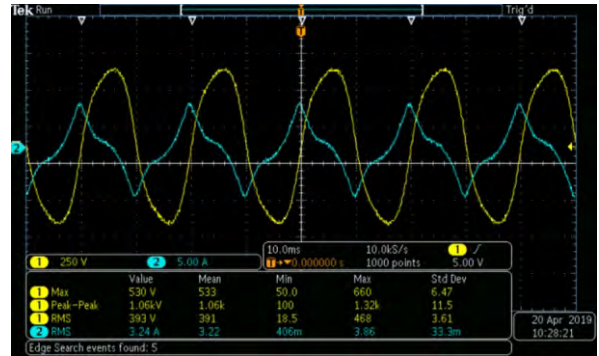


Fig. 2 – Waveform at 240V

To design a high reliable capacitor, we investigated the application first and analysed the electrical stress across the capacitor. We measured the electrical stress across the capacitor at full speed at 230V (Fig. 1) and 240V (Fig. 2) and comprehend that the RMS voltage across the capacitor is 384V and 393V at 230V and 240V, respectively.

Adding a safety margin to that, a 440VAC rated capacitor is suggested for this application.

### Conventional Manufacturing Process of Fan Motor Run Capacitor

The conventional fan motor capacitor manufacturing process adopted by existing manufacturers begins with cylindrical core type winding followed by heat treatment, metal spray, clearing, soldering, PU resin filling (Non-flame retardant type), testing and packing. The removal of air trapped inside the capacitor is not ensured in this process (between the dielectric film and around the metal spray area). The presence of air inside the capacitor causes the corona effect, which eventually results in dielectric failure. Corona discharge is an electrical discharge caused by the ionization of a fluid such as air surrounding a conductor that is electrically discharged. Corona discharge is a small but powerful electrical discharge that injects charge into the insulating film around the borders of metallisation or where air is trapped between the metallised films. A voltage gradient big enough to ionise molecules in the film or small air pockets causes the discharge.

Each discharge damages the film in a minor but cumulative way.

Corona is a critical factor to consider in AC and/or pulse applications where cumulative damage can quickly accumulate and cause dielectric failure. This will eventually cause a short circuit in film sections.

The "clearing" around the dielectric failure sites causes accumulated capacitance loss in metallized film capacitors.

### CORONA EFFECT / CORONA DISCHARGE...



In order to minimize the air packets, core type winding wound elements are often produced with increased winding tension which can cause the damage to the dielectric film.

## Deki's Innovative Manufacturing Process of Fan Motor Run Capacitor

Deki, with its extensive film capacitor manufacturing experience, has all the necessary resources to produce high-reliability film capacitors for almost every application. For all new product development, the FMEA tool is used as a standard to ensure the quality of the product.

To solve above mentioned problems faced by the fan manufacturers, the Deki's technical center devised a creative solution. Deki fan capacitors are constructed with high-quality (Grade A) high temperature Metallized Polypropylene film that is wound with controlled tension to avoid harming the dielectric. The wound element is then pressed under regulated conditions, such as pressure, pressing time, and temperature. Optimization of all three parameters is critical to extending the capacitor's life. Pressed elements are metal sprayed and short cleared before welding/soldering operation. After welding/soldering each and every capacitor is impregnated with an insulation medium. In this process trapped air is removed from the capacitor and filled with the insulating material. This will improve the electrical characteristics of the capacitor dramatically.

Following the impregnation process, the capacitor is encapsulated with electrical grade adhesive material which improves mechanical strength and prevents excessive self-healing during the capacitor's working life. The capacitors are then tested and assembled inside a cylindrical or rectangular container, and filled with resin to ensure

environmental protection over a long life. Thereafter capacitors undergo rigorous testing and OQC.

### Deki Range

Deki's fan capacitor range is approved by BIS as per IS: 1709-1984.

**Capacitance Value:** 0.68  $\mu\text{F}$  to 4.0  $\mu\text{F}$

**Rated Voltage:** 440 VAC



### Endurance Test Condition

According to BIS as per IS: 1709-1984 we have performed the life test for capacitors made with special process and standard process at our lab and found that capacitors made with special process is performing consistently well compared to others.

Testing Conditions as per IS:1709-1984	
Applied Voltage	550VAC
Total Test Duration	500 hours
Test Criteria	$\Delta\text{C/C} \leq 5\%$ , $\Delta\text{tan}\delta < 0.002$

Ref NO.	ET21-26			Test Type	Endurance Test				
Rated Cap.	2.25 $\mu\text{F}$			Applied Voltage	550VAC				
Rated Voltage	440VAC			Temperature	85°C				
Tolerance	5%			Test Duration	500 Hours				
Item Code	137 225 J 06 1 D			Visual appearance	OK				
Category	MPP-SH			Lot. No	106070761				
Initial measurements				Measurements after 500 hours					
Pcs No.	Cap. 1kHz	tan d 50Hz	tan d 1kHz	IR 500VDC	Cap. 1kHz	tan d 50Hz	tan d 1kHz	IR 500VDC	$\Delta\text{C/C}$ in %
<b>Deki Capacitor 2.25<math>\mu\text{F}</math>/5%/440VAC</b>									
1	2.2219	0.0001	0.0004	90000	2.2180	0.0002	0.0008	95000	-0.18
2	2.2471	0.0001	0.0004	90000	2.2428	0.0001	0.0005	110000	-0.19
3	2.2401	0.0001	0.0004	110000	2.2351	0.0001	0.0005	115000	-0.22
4	2.2641	0.0001	0.0004	90000	2.2605	0.0001	0.0005	120000	-0.16
5	2.2621	0.0001	0.0004	110000	2.2573	0.0001	0.0005	115000	-0.21
6	2.2771	0.0001	0.0005	110000	2.2739	0.0001	0.0011	125000	-0.14
7	2.2647	0.0001	0.0004	110000	2.2596	0.0002	0.0006	125000	-0.23
8	2.2087	0.0001	0.0004	100000	2.2027	0.0001	0.0009	120000	-0.27
9	2.2441	0.0001	0.0004	110000	2.2376	0.0002	0.0006	120000	-0.29
10	2.2559	0.0001	0.0004	110000	2.2474	0.0002	0.0020	125000	-0.38
<b>Maximum</b>	<b>0.0001</b>	<b>0.0001</b>	<b>0.0005</b>	<b>110000</b>	<b>2.2739</b>	<b>0.0002</b>	<b>0.0020</b>	<b>125000</b>	<b>-0.14</b>
<b>Minimum</b>	<b>0.0001</b>	<b>0.0001</b>	<b>0.0004</b>	<b>90000</b>	<b>2.2027</b>	<b>0.0001</b>	<b>0.0005</b>	<b>95000</b>	<b>-0.38</b>
<b>Average</b>	<b>0.0001</b>	<b>0.0001</b>	<b>0.0004</b>	<b>103000</b>	<b>2.2435</b>	<b>0.0001</b>	<b>0.0008</b>	<b>117000</b>	<b>-0.23</b>
<b>STDEV</b>	<b>0.0000</b>	<b>0.0000</b>	<b>0.0000</b>	<b>9487</b>	<b>0.0213</b>	<b>0.0001</b>	<b>0.0005</b>	<b>9189</b>	<b>0.07</b>
<b>Brand-1 Capacitor (2.5<math>\mu\text{F}</math>/5%/440VAC)</b>									
1	2.5700	0.0001	0.0006	100000	2.5071	0.0003	0.0015	80000	-2.45
2	2.5036	0.0001	0.0007	80000	2.4305	0.0004	0.0025	65000	-2.92
<b>Brand-2 Capacitor (2.5<math>\mu\text{F}</math>/5%/440VAC)</b>									
1	2.6753	0.0001	0.0007	13000	2.5303	0.0015	0.0070	100	-5.42
2	2.5057	0.0001	0.0009	15000	2.4363	0.0024	0.0095	8000	-2.77
<b>Brand-3 Capacitor (3.15<math>\mu\text{F}</math>/5%/440VAC)</b>									
1	3.2028	0.0001	0.0004	90000	3.0414	0.0002	0.0011	40000	-5.04
2	3.2101	0.0001	0.0005	100000	3.1090	0.0003	0.0015	45000	-3.15

The test result shows that the drop in capacitance value in Deki capacitors after the test is minor as compared with other brands. That is why the reliability of these capacitors is high.





## Another Feather in Our Cap

We are proud to announce that Deki Electronics has been awarded for Outstanding Contribution in Promotion of Electronics in Electronic Components Ecosystem category by the Ministry of Electronics and Information Technology, Government of India.

Mr Vinod Sharma, our Managing Director, received the award from the minister, Mr Ashwini Vaishnav, on behalf of Team Deki, on December 1, 2021.

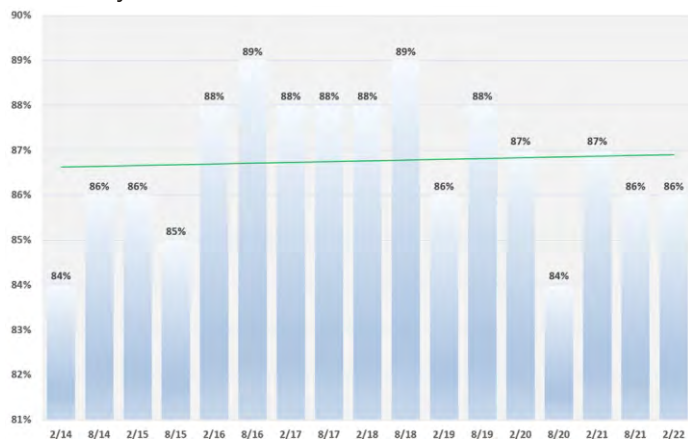


## Employee Satisfaction Survey

Deki also conducts an employee satisfaction survey every six months in which all direct employees are asked fifteen questions pertaining to:

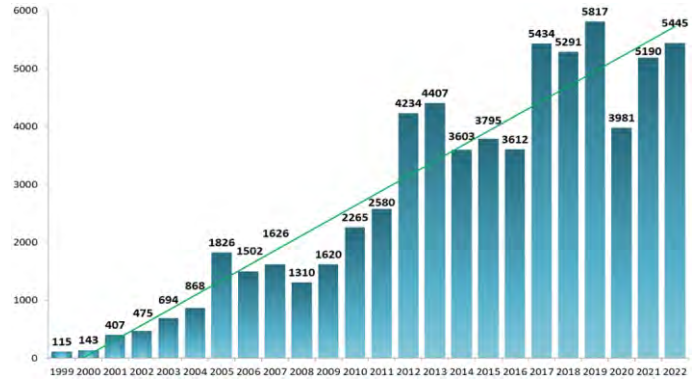
1. Their work environment
2. Salary
3. Satisfaction level
4. Growth opportunity
5. Knowledge of targets, standard specifications, operating procedures, etc.

Marks are accorded to each question and then consolidated into a report that compares the results of the most recent survey with the previous one. This consolidated report, along with the action points for improvement, are discussed with all the employees in an 'Open House' by Mr Vinod Sharma, our Managing Director. The February 2022 survey showed an overall stable trend of 79%.



## Training is Important at Deki

Training in Deki receives utmost importance and, as an integral part of continual skill enhancement, it has been growing consistently. Detailed stage wise training is being conducted in which knowledge of the process and the machines is being imparted followed by a written test. An employee has to score a minimum of 80% at critical stages to qualify to run the machine. Deki's training modules have been well recognised and serve as a benchmark for component manufacturers. At Deki we spend more than 5% of the time on training. After the pandemic in 2020 the training graph is on the rise once again.



## Sometimes one needs to speak from the heart!

ELCINA organised the 2nd Electronic Supply Chain Summit on March 25, 2022 in NOIDA with a conference on creating a credible component eco-system in India by 2025. Speaking from the heart, Mr Vinod Sharma, our Managing Director, asked Indian manufacturers to work with Indian vendors to develop a robust supply chain. He said that companies needed to look beyond profitability to focus on helping the country become a versatile manufacturing powerhouse. Take 13½ minutes to see the video at <https://youtu.be/auDckFiAN9c>.



## The 2-in-1 X2 Capacitor Range from Deki

The Deki X2 range of capacitors now come with dual approval from UL and ENEC. Earlier, we had one series of X2 capacitors with UL approval and another with ENEC approval. Now, we offer one series of X2 capacitors with both the approvals. This means simpler ordering, especially for those who require capacitors with UL and ENEC approvals.

Another step in our Aatmanirbhar Bharat journey that began way back in 1984 and we are truly vocal for local!

