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CHARGE

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A Technical News Journal from Deki Electronics Ltd

Editor's Desk

Dear Readers,

As power-electronic systems evolve towards **higher efficiency, greater power density and longer service life**, DC-Link capacitor selection has become increasingly important. Aluminium electrolytic capacitors have traditionally been used for their high capacitance and cost-effectiveness, but limitations in **ripple-current capability, thermal performance and service life** are encouraging designers to consider alternatives.

This issue of **CHARGE** explores the replacement of electrolytic DC-Link capacitors with film capacitors, highlighting **lower ESR, higher ripple-current capability, improved thermal stability and longer operating life.** It also considers practical factors such as capacitance, voltage rating, physical size, system layout and overall cost.

By comparing both technologies, the article provides engineers with practical guidance on when film capacitors can offer a **more reliable and durable solution** for modern power-electronic applications.

Shankar Raj

DEKI ELECTRONICS AT PCIM EUROPE 2026

Deki Electronics participated in PCIM Europe 2026, held from **9–11 June in Nuremberg, Germany**, showcasing its expanding range of film capacitor solutions for advanced power electronics applications. The exhibition provided an important international platform for Deki to engage directly with OEMs, engineering teams, sourcing professionals and distribution partners from **more than 12 countries**.

Across the three-day event, discussions focused on application requirements in power conversion, e-mobility, renewable energy, UPS systems and industrial automation. Visitors explored Deki's portfolio of **DC-Link, snubber, EMI-suppression, AC-filter and motor-run capacitors**, along with the company's engineering support, qualification capabilities and long-standing film capacitor manufacturing expertise.

A recurring theme was the need for **a reliable second source capable of supporting technical customisation, consistent quality and supply-chain continuity.** International visitors discussed extending existing relationships into European projects, while distributors explored opportunities to introduce Deki's capacitor solutions in their local markets. The participation strengthened Deki's international visibility and reinforced its position as an Indian manufacturer equipped to support demanding global power-electronics applications.

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RETHINKING THE DC-LINK

The Shift from Electrolytic to Film Capacitors

"Today's designers are increasingly choosing film capacitors not because they require higher capacitance, but because they demand higher ripple current capability, longer service life, improved reliability and greater system efficiency."

INTRODUCTION

Electric vehicles, renewable energy, battery storage, industrial automation, UPS systems, fast EV chargers, railway traction and aerospace electronics all demand **higher efficiency, greater power density and longer service life.**

At the heart of every modern power converter sits the DC-Link capacitor, which smooths the DC bus, supplies instantaneous energy and absorbs the high-frequency ripple current generated by switching devices.

For decades, aluminium electrolytic capacitors dominated this role because they delivered high capacitance at low cost. Today, designers worldwide are increasingly replacing electrolytic capacitor banks with metallized polypropylene film capacitors in high-frequency switching systems — not because they need more capacitance, but because they need better performance, longer life and higher reliability. That shift is changing how DC-Link capacitors are selected.

THE TRADITIONAL APPROACH — AND WHERE IT FALLS SHORT

In high-frequency switching converters, DC-Link capacitors were traditionally sized to meet ripple current alone — for example, an inverter needing 56 Arms with capacitors rated 14 Arms each would need four in parallel, and at 4,700 µF each, that bank balloons to 18,800 µF, far more than the application needs. A common misread follows: that replacing it requires an equally large film capacitor. It doesn't — particularly at higher switching frequencies, into the tens or hundreds of kHz with SiC/GaN devices, where film's low ESR and ESL let a much smaller capacitance outperform the electrolytic bank.

The purpose of a DC-Link capacitor is not to provide a particular capacitance value — it is to perform an electrical function. The objective is to replace that function, not the number on the label.

This applies where ripple current and ripple voltage drive sizing, as in most inverters and DC-Link applications — not to low-frequency mains smoothing or energy hold-up duty, where capacitance itself is the design target.

RIPPLE CURRENT VS. RIPPLE VOLTAGE — THE REAL SELECTION CRITERIA

A DC-Link capacitor performs two distinct jobs, and confusing them is what drives oversized electrolytic banks:

- **Ripple current:** the capacitor must safely carry the AC ripple current generated by PWM switching without overheating.
- **Ripple voltage:** the capacitor must keep DC-bus voltage variation within the limit the application allows.

Electrolytic capacitors are almost always selected based on ripple-current capability rather than ripple voltage, so their capacitance ends up far higher than the application needs, while the resulting ripple voltage ends up far lower than the allowable limit. Film capacitors have much higher ripple current capability per unit volume, which lets designers size capacitance around allowable ripple voltage instead — typically a far smaller number.

As a general guide, most power electronic applications allow a ripple voltage of around 1–3% of the DC bus voltage — the exact figure depends on the specific design.

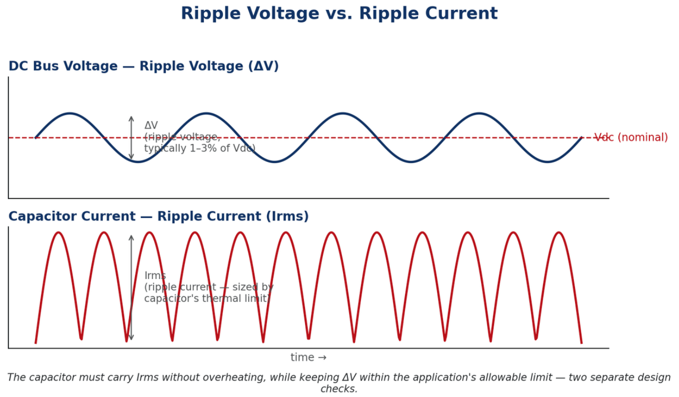

Fig. 1 — Ripple voltage (small variation on the DC bus) vs. ripple current (the AC current the capacitor must carry)

The same principle scales up to a high-power bus-link application — and the sizing arithmetic behind it is worth walking through, because it shows both ripple current and ripple voltage being checked properly, not just assumed.

The case study below makes this concrete through an illustrative worked example at full bus-link scale.

CASE STUDY — SIZING A BUS-LINK CAPACITOR BANK

Consider a **500 kVA solar inverter** with an **800 Vdc nominal bus**, a 4 kHz switching frequency, a required bus-link ripple current of **100 Arms**, and a ripple-voltage limit of **2% of bus voltage**. Typical ambient conditions run 45°C to 65°C, with excursions to 80°C.

Existing Electrolytic Solution

The incumbent design uses discrete electrolytic capacitors rated 4,700 µF / 450 Vdc, each capable of 22 Arms ripple at 4 kHz with an ESR of 18 mΩ.

Because no single capacitor meets both the bus voltage and ripple current requirements, the bank is built as 2 capacitors in series (for voltage) by 5 legs in parallel (for current):

- Working voltage: 450 V × 2 = 900 Vdc
- Ripple current capability: 22 Arms × 5 = 110 Arms
- Bank capacitance: (4,700 µF ÷ 2) × 5 = 11,750 µF
- Bank ESR: (18 mΩ × 2) ÷ 5 = 7.2 mΩ
- Ripple voltage: ΔV ≈ 2.1 V ≈ 0.3% of bus voltage — well within the 2% limit

As with the smaller example earlier, this bank was never sized for 11,750 µF — that capacitance is simply the by-product of arranging ten capacitors to satisfy voltage and ripple-current requirements.

Film Capacitor Solution

A film capacitor rated approximately 1,000 µF / 900 Vdc, with around 70 Arms ripple capability at 65°C and an ESR of about 2 mΩ, can be used two-in-parallel to meet the same voltage, current and ripple-voltage requirements — **replacing all ten electrolytic capacitors with just two parts:**

- Ripple current capability: 70 Arms × 2 = 140 Arms (comfortably clears the 100 Arms requirement)
- Bank capacitance: 1,000 µF × 2 = 2,000 µF
- Bank ESR: 2 mΩ ÷ 2 = 1 mΩ
- Ripple voltage: $\Delta V \approx$ 12.5 V ≈ 1.6% of bus voltage — within the 2% limit
- Capacitance ratio: 11,750 µF ÷ 2,000 µF ≈ **5.9× less capacitance — using 2 components instead of 10**

At an operating ripple current of ~52 Arms shared across the two capacitors (~26 Arms each), each dissipates roughly 1.35 W — a modest few-degree temperature rise, comfortably within rating.

If the allowed ripple voltage were relaxed to 3%, the minimum capacitance needed to meet ripple voltage alone would drop to about 1,042 µF — pushing the theoretical capacitance ratio to roughly 11.3× less than the electrolytic bank.

A Safety Benefit, Too

Oversized electrolytic banks also store more energy at shutdown, often requiring dedicated discharge circuitry that adds cost and complexity. A right-sized film bank stores far less, easing this requirement.

WHEN DOES FILM ACTUALLY WIN ON COST?

"Are film capacitors always cheaper?" The honest answer: it depends on the power level.

Small Power Supplies (LED drivers, CFL, small SMPS, consumer electronics)

Here, swapping one small electrolytic capacitor for one film capacitor can raise component cost. The decision is usually driven by lifetime, reliability, high-temperature operation, THB (temperature-humidity-bias) performance and maintenance-free operation — not price alone.

Medium and High Power Systems (solar inverters, EV chargers, motor drives, UPS, wind converters, BESS)

The economics flip. Instead of four, six or even twelve paralleled electrolytic capacitors, one or two film capacitors often suffice, bringing:

- Fewer components and a smaller bus structure
- Lower ESR, lower losses, less heating
- Longer operating life and lower maintenance
- Improved overall system reliability

Comparing capacitors by cost-per-microfarad misses this. The meaningful comparison is **total system cost** — capacitor count, busbars, mounting space, assembly time, cooling, service life and maintenance. On that basis, a single high-performance film capacitor frequently costs less over the product's life than a bank of electrolytics, even if its unit price is higher.

FILM VS. ELECTROLYTIC — AT A GLANCE

Parameter	Aluminium Electrolytic	Metallized Film
Ripple current capability	Moderate	Excellent
ESR / ESL	Higher	Very low
Self-healing	No	Yes
Thermal stability	Moderate	Excellent
Service life	Limited by electrolyte ageing	Very long
Parallel capacitors typically needed	Often several	Usually one
Maintenance	Periodic replacement likely	Generally maintenance-free

Film capacitors haven't made electrolytics obsolete — for low-power, cost-sensitive designs, electrolytics remain the practical choice. But as switching frequencies rise with SiC and GaN devices, and as ripple current, thermal performance and 10-20-year service life become the deciding factors, film capacitors increasingly become the better engineering — and total-cost — choice.

DEKI DC-LINK CAPACITORS — ENGINEERED FOR MODERN POWER ELECTRONICS

Deki Electronics offers one of India's widest ranges of metallized polypropylene DC-Link capacitors, covering compact industrial supplies through to high-power inverters, traction converters and EV systems.

Series No.	Capacitor Type	Voltage Range	Capacitance Range
91	DC-Link Box Plastic	450–1600 VDC	0.68 µF – 210 µF
292 / 293	DC-Link Round Plastic	600–2000 VDC	20 µF – 270 µF
297	DC-Link Round Aluminium Can	700–3000 VDC	45 µF – 5,500 µF
398	Customized DC-Link for EV Applications	450–1200 VDC	300 µF – 1,000 µF

Designed and Validated to International Standards

All Deki DC-Link capacitors are designed, tested and validated to **IEC 61071**, the internationally recognised standard for power electronic capacitors. Railway and automotive variants can additionally be qualified to **IEC 61881-1** and **AEC-Q200** respectively.

LOOKING AHEAD

As SiC and GaN devices push switching frequencies higher, demand will keep growing for capacitors with superior ripple current capability, low ESR, excellent thermal stability and long life. Film capacitors are no longer simply an alternative to electrolytics — they are becoming a key enabling technology for next-generation power conversion.

The lowest-cost capacitor is not always the lowest-cost solution. Modern DC-Link design optimises the complete system — not just the capacitance value.

NEED ASSISTANCE WITH YOUR DC-LINK CAPACITOR SELECTION?

Deki's technical specialists can visit customer locations to understand application requirements, recommend suitable capacitor solutions, and support sample evaluation, testing and qualification.

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DEKI CONTRIBUTES TO INDIA'S ELECTRONICS MANUFACTURING AND EXPORT ROADMAP

Deki Electronics participated in Electronics Chintan Shivir 2026, held on **10 July at Bharat Mandapam, New Delhi.** The forum brought together senior government officials and industry leaders to discuss the next phase of India's electronics manufacturing growth.

Deki's Managing Director, **Mr. Vinod Sharma**, contributed to discussions on strengthening **domestic component and semiconductor ecosystems**, increasing MSME participation, expanding India's role in **global value chains** and advancing **manufacturing and export ambitions**.

Deki remains committed to supporting a stronger and globally competitive electronics ecosystem through innovation, quality manufacturing and industry collaboration.

EMPLOYEE SATISFACTION SURVEY – FEBRUARY 2026

The Employee Satisfaction Survey conducted in February 2026 recorded an improvement in Executive satisfaction, rising from **79% to 80%,** while the Non-Executive category maintained a strong satisfaction score of **87%.** Participation levels also remained strong, reflecting continued employee engagement.

Positive feedback was received on recognition, supervision, resource availability, work culture, respect and management support. The results reflect a positive workplace environment and sustained employee confidence across the organisation.

The feedback will support ongoing initiatives in employee development, communication, training and cross-functional collaboration, reinforcing Deki's commitment to an engaged and continuously improving workplace.

EXTERNAL CUSTOMER SATISFACTION SURVEY

At Deki Electronics, the External Customer Satisfaction Survey has supported our continuous improvement journey for over two decades. Conducted twice a year, it helps us understand customer expectations, recognise strengths and identify areas for improvement.

The latest completed survey, concluded in December 2025, recorded an overall satisfaction score of **91.52%** across quality, delivery, professionalism and customer experience. It also achieved a **Net Promoter Score of 84,** reflecting strong customer loyalty and willingness to recommend Deki.

We sincerely thank our customers for their continued support and valuable feedback, which guide our efforts to improve performance and strengthen long-term partnerships.

BUILDING A HEALTHIER WORKPLACE AT DEKI

Deki Electronics continued its focus on employee health and well-being through wellness initiatives in 2026. Health check-up camps were organised in March, where **485 employees** participated across sessions covering BMI, blood sugar, ECG, eye and dental check-ups, along with specialist consultations.

Another health check-up camp was conducted in July in association with **Metro Hospitals & Heart Institutes**, benefiting **150+ employees** through BP monitoring, sugar checks, ECG, eye check-ups and doctor consultations.

The diabetes awareness session and **International Yoga Day** programme also encouraged preventive healthcare, physical fitness and mental well-being. These initiatives reflect Deki's commitment to building a healthier, more engaged workplace.