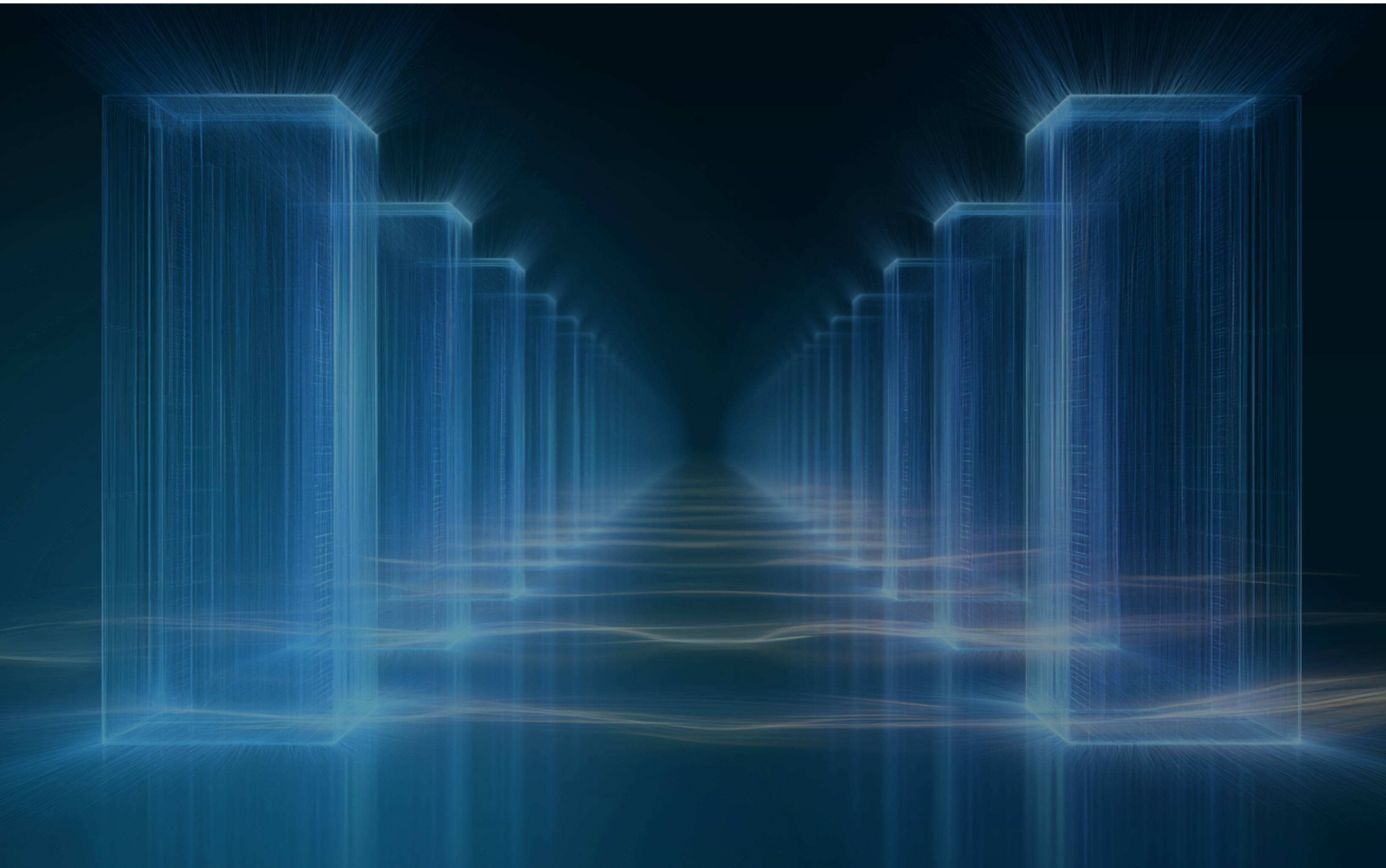
WHITEPAPER

THE MOVE TO DC DATA CENTERS

The role of advanced capacitors, and how Peak Nano's NanoPlex™ technology enables the shift to 800 VDC.



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LENGTH · 16 PAGES

01

01 · EXECUTIVE SUMMARY

WHY THE 800 VDC MOMENT MATTERS

Capacitors are the technology that keeps the AI factory online. Here is why, and where NanoPlex fits.

> **NanoPlex film capacitors deliver up to 4× the energy density of BOPP, with a 135 °C ceiling and a U.S. supply chain. It is the dielectric platform NVIDIA's 800 VDC AI factory demands.**

NVIDIA DSX **is a comprehensive framework and reference design for building and operating gigawatt-scale "AI factories." It aims to maximize model output (tokens per watt) by co-designing compute, power, cooling, and networking into a single unified system.**

Powering DSX is the **NVIDIA 800 VDC Architecture**, a power distribution system designed for AI factories housing massive clusters of high-power GPUs. Its core components include a grid-to-rack distribution system that converts grid power to 800 VDC at the facility perimeter, the Kyber rack architecture, and hybrid energy storage. End-to-end power efficiency improves to 92%, with copper inside the rack reduced by 45%.

The most critical component of the 800 VDC architecture is the capacitor, which appears at multiple points in the system. Historically, electrolytic capacitors were used in power-supply stages of AC-powered systems, but aluminum electrolytic capacitors top out at roughly 500 VDC. Film capacitors clear 800 VDC easily; the typical material is biaxially oriented polypropylene (BOPP), with a 105 °C thermal ceiling and a volume-to-capacitance metric well below electrolytic.

Peak Nano's NanoPlex™ material closes the gap. Its 135 °C thermal rating sits above the temperature range most likely to be experienced in this application, reducing the likelihood of thermal failures that could compromise an entire rack of GPUs. NanoPlex LDF capacitors deliver up to 4× the energy density of standard film, enabling capacitors that are 50% smaller and lighter than BOPP equivalents.

92%

END-TO-END EFFICIENCY

NVIDIA DSX 800 VDC architecture vs. 85–88% for the legacy AC chain it replaces.

IN BRIEF

THE 800 VDC SHIFT

Kyber-class racks at 600 kW–1 MW make AC distribution physically untenable. NVIDIA's DSX reference design moves all distribution to 800 VDC, and that change rewrites the capacitor bill of materials.

02

INTRODUCTION

THE MOVE TO DC DATA CENTERS

Data centers have operated on AC distribution for decades. That era is ending. The physics of AI compute is forcing the industry to 800 VDC.

Data centers have operated on alternating current (AC) power distribution for decades. That era is ending. The growth of AI workloads, driven by GPU computing at power densities well beyond what was typical five years ago, has exposed the fundamental limitations of AC architecture and is forcing the industry toward direct current (DC) distribution, specifically 800-volt DC (800 VDC), as the foundation for AI factories.

This paper examines the forces driving the transition from AC to DC data centers, the specific architecture that NVIDIA's Vera Rubin DSX AI Factory reference design establishes as the industry standard, the critical role that capacitors and power converters play in the new DC power chain, and how Peak Nano's NanoPlex LDF and HDC nanocomposite films are purpose-built to meet the demands of this new infrastructure.

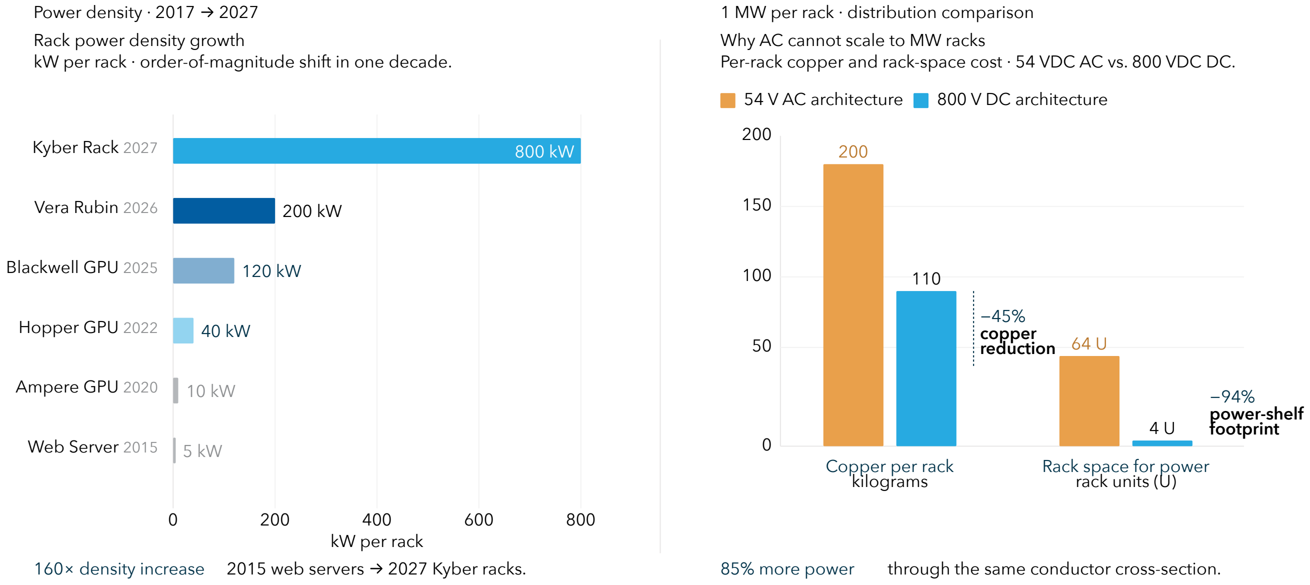


FIGURE 01 GPU rack power density growth (left) and why AC architecture cannot scale to MW-class racks (right).

THE AI POWER DENSITY PROBLEM

GPU rack power density has increased by orders of magnitude in a single decade. Standard web server racks drew 5–10 kW. Today's NVIDIA Blackwell-based systems require 120 kW per rack. The Vera Rubin NVL72, shipping now, exceeds 200 kW. And the Kyber rack platform, expected in 2027, targets 600 kW to 1 MW per rack.

At these densities, the traditional AC power distribution model, with its multiple conversion stages, massive copper requirements, and wasted rack space, cannot scale.

WHY 800 VDC?

The choice of 800 VDC as the distribution standard is driven by physics and economics. Distributing 1 MW at legacy 54 VDC would require up to 200 kg of copper busbar per rack and consume up to 64U of rack space for power shelves, leaving no room for compute.

The 800 VDC architecture delivers 85% more power through the same conductor cross-section, reduces copper use by up to 45%, and eliminates AC switchgear, AC PDUs, and per-rack AC/DC power supplies entirely. It also aligns with the 800 V architecture adopted by the EV industry, leveraging mature SiC and GaN power conversion devices and their associated cost curves.

ARCHITECTURE SHIFT

AC VS. DC: HOW DATA CENTER POWER ARCHITECTURE IS CHANGING

03

Understanding the magnitude of the DC transition requires a clear picture of what AC looks like, what 800 VDC replaces it with, and why the efficiency gains translate directly into more GPUs per megawatt.

THE LEGACY AC POWER CHAIN

In a conventional AC-powered data center, utility power follows a complex path from the grid to the server. High-voltage AC from the utility is stepped down through transformers, fed into uninterruptible power supply (UPS) systems for battery-backed ride-through, distributed through AC power distribution units (PDUs) to each rack, and finally converted from AC to DC inside each server's individual power supply unit (PSU).

Each stage introduces energy losses, heat generation, failure points, and physical space requirements. End-to-end efficiency typically ranges from 85–88%, meaning 12–15% of all power drawn from the grid is wasted before it reaches a GPU.

WHERE THE 12-15% GOES

MV→LV step-down transformer	~2%
UPS double-conversion	3–5%
AC PDU distribution	~1%
Server PSU (AC→DC)	5–7%
END-TO-END LOSS	**12–15%**

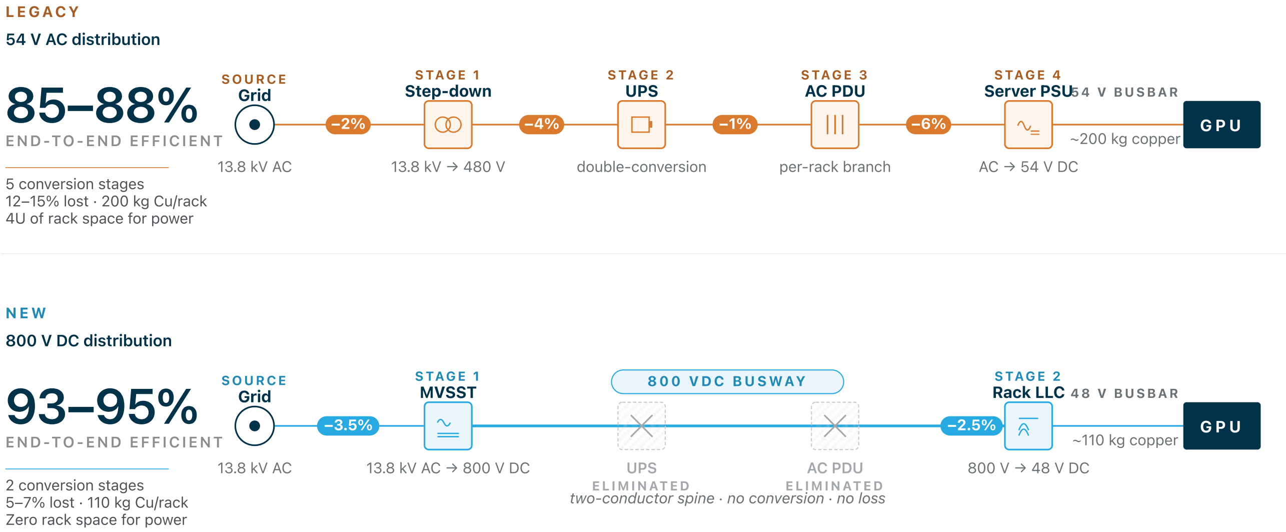


FIGURE 02 Side-by-side: the legacy 54 V AC chain (five conversion stages) vs. the 800 V DC chain (two stages).

> 12-15% of all power drawn from the grid is wasted before it reaches a GPU under legacy AC distribution.

DISTRIBUTION LAYERS

The DSX architecture defines six discrete distribution layers from the facility perimeter to the rack. Each layer creates a distinct capacitor requirement.

DISTRIBUTION LAYER	PHYSICAL MEDIUM	ROLE	CAPACITOR RELEVANCE
Perimeter AC-to-DC	MVSST or industrial rectifier	Converts 13.8 kV AC to regulated 800 VDC	MPPF / NanoPlex LDF DC bus filter caps at output
800 VDC Busway	Two-conductor copper / aluminum bus duct	Primary distribution spine to compute rows	Film caps in busway protection & surge suppression
Row / Pod Distribution	DC Remote Power Panels (RPP)	Branch circuit protection and metering	Film caps in RPP filter stages
Rack Power Unit (RPU)	800 VDC input · LLC converter to 48V/12V	Single-stage DC-DC conversion	NanoPlex LDF resonant tank & DC bus filter caps
Rack Energy Storage	Energy Variance Appliance (EVA)	Absorbs GPU transients at 400 J/GPU	NanoPlex LDF supercap hybrid or DC link film caps
Facility BESS	High-voltage battery arrays	Long-duration ride-through	Film caps in BESS inverter DC link

TABLE 1 800 VDC power distribution layers and capacitor relevance in the DSX architecture

Source: NVIDIA Vera Rubin DSX AI Factory reference design.

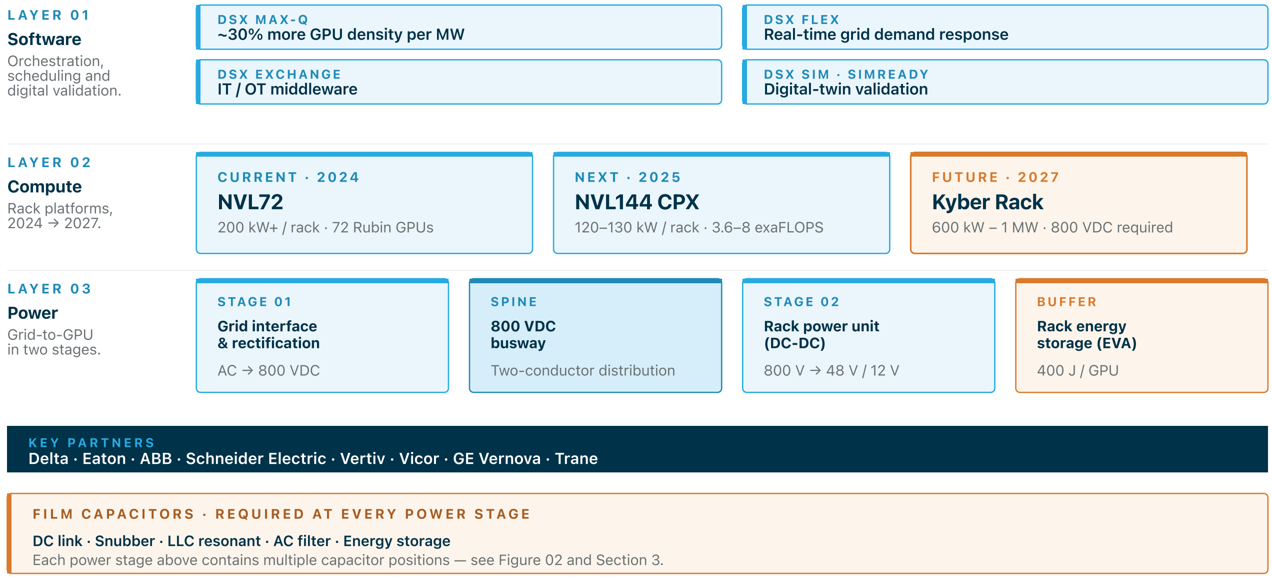


FIGURE 03 NVIDIA DSX AI Factory architecture: software, compute, and power layers.

04

ROLE OF CAPACITORS

THE ROLE OF CAPACITORS IN THE DC DATA CENTER

Capacitors are the most critical passive component in a DC data center. They ensure DC voltage quality across every stage of the power chain, from the facility perimeter to the individual GPU.

A typical 100 MW DC data center contains 130,000 to 220,000 pounds of capacitors distributed across primary power systems. In the 800 VDC architecture, film capacitors become essential for the high-voltage, high-frequency applications that electrolytic capacitors cannot reliably serve.

WHY NVIDIA SPECIFIES CAPACITORS, NOT BATTERIES

GPU workloads in AI factories are synchronized across entire data centers, creating massive load swings in very short time intervals. When thousands of GPUs shift simultaneously between training phases, power demand can spike or drop by hundreds of kilowatts per rack in microseconds.

NVIDIA’s MGX rack architecture explicitly specifies capacitors, not batteries, for rack-level power smoothing, with 400 joules of energy storage per GPU (28,800 J per 72-GPU rack), 6× more storage than prior generations. This "Intelligent Power Smoothing" system eliminates the need for large battery packs while reducing peak current demands by up to 25%. Capacitors respond in microseconds; batteries cannot.

400 J

PER GPU AT RACK LEVEL

NVIDIA MGX specification. 6× more storage than prior generations; capacitors, not batteries.

WHERE CAPACITORS ARE USED IN THE 800 VDC POWER CHAIN

Film capacitors serve distinct and critical functions at each stage of the 800 VDC power distribution architecture. At the perimeter rectifier, they provide AC EMI filtering on the input and DC bus filtering at the output of the AC-to-800 VDC conversion.

Along the 800 VDC busway, they serve in protection, filtering, and surge suppression modules. At the row and pod distribution level, they filter DC power in remote power panels. At the rack power unit, they function as LLC resonant tank capacitors and DC bus filter capacitors in the 800 VDC-to-48 V conversion stage. And at the rack level, they provide the bulk energy storage that enables Intelligent Power Smoothing at 400 J/GPU.

Where capacitors sit in the 800 VDC power chain

Five conversion stages from grid to GPU — each with a distinct capacitor role. EVA buffer absorbs synchronized GPU transients.

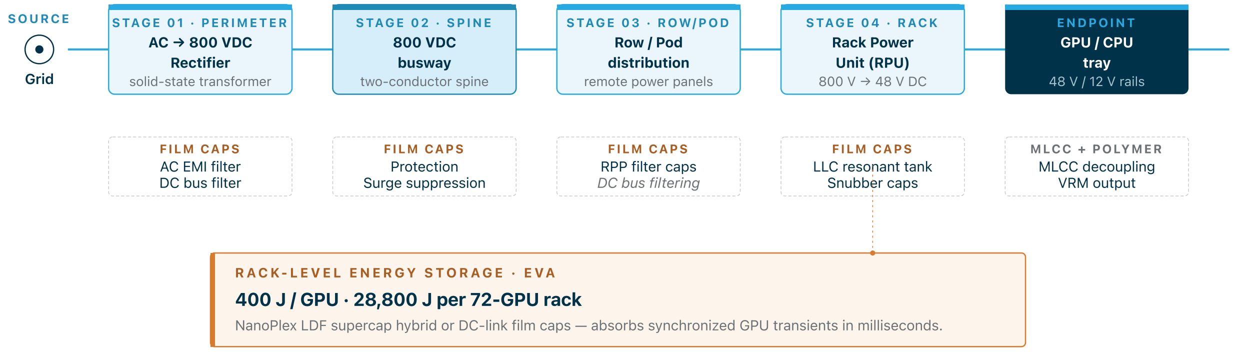


FIGURE 04 Film capacitor positions across the 800 VDC power chain.

FILM VS. ELECTROLYTIC CAPACITORS: A POSITION-BY-POSITION ASSESSMENT

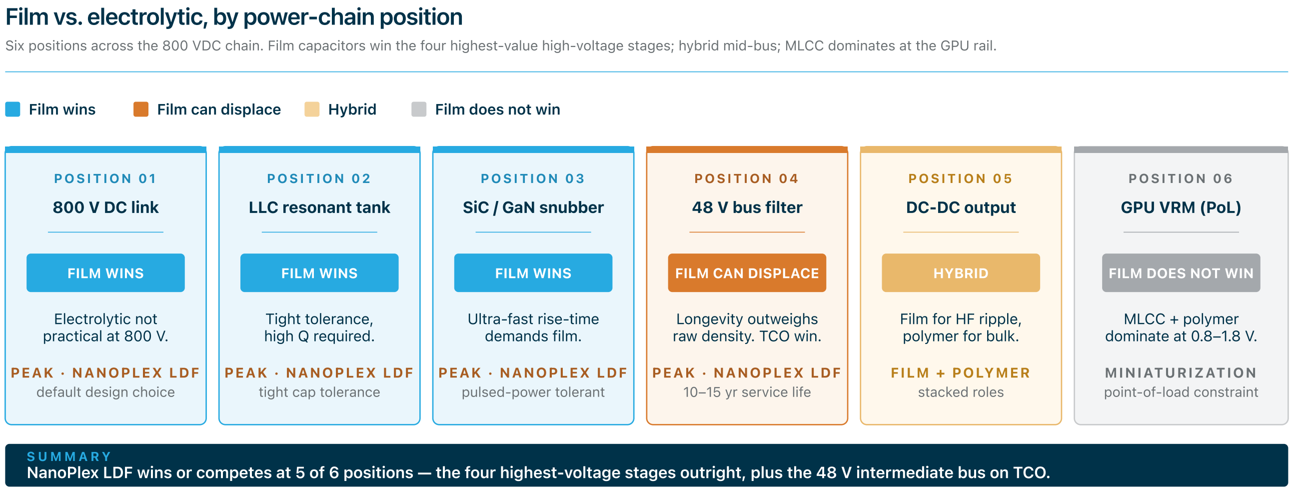
In AC-powered server racks, electrolytic capacitors have historically played a significant role in power conversion. Their high capacitance-to-volume ratio makes them attractive for energy storage, ripple current filtering, and voltage smoothing.

However, they have significant shortcomings in high-voltage DC systems like the 800 VDC architecture used in NVIDIA’s DSX. The voltage rating of electrolytic capacitors (even specialized parts) seldom exceeds 500 VDC. The typical alternative, high-voltage film capacitors, has a lower capacitance-to-volume ratio, leading to larger circuit footprints.

At the 800 VDC DC link, LLC resonant tank, SiC/GaN snubber, and AC EMI filter positions, electrolytic capacitors are not practical. NanoPlex LDF is the default design choice for these positions, and the only credible option.

At the 48 V intermediate bus, film can displace electrolytic when long service life and temperature stability outweigh raw capacitance density, justified by total cost of ownership over a 10–15-year AI factory service life. The one area where film does not compete is point-of-load GPU VRM output at 0.8–1.8 V, where MLCC–polymer electrolytic combinations dominate due to miniaturization requirements.

> **"NanoPlex LDF eliminates electrolytics from positions where they are already failing under AI workloads, and reduces service-call rates."**



Film vs. electrolytic, by power-chain position

Six positions across the 800 VDC chain. Film capacitors win the four highest-value high-voltage stages; hybrid mid-bus; MLCC dominates at the GPU rail.

■ Film wins ■ Film can displace ■ Hybrid ■ Film does not win

POSITION 01	POSITION 02	POSITION 03	POSITION 04	POSITION 05	POSITION 06
800 V DC link	LLC resonant tank	SiC / GaN snubber	48 V bus filter	DC-DC output	GPU VRM (PoL)
FILM WINS	FILM WINS	FILM WINS	FILM CAN DISPLACE	HYBRID	FILM DOES NOT WIN
Electrolytic not practical at 800 V.	Tight tolerance, high Q required.	Ultra-fast rise-time demands film.	Longevity outweighs raw density. TCO win.	Film for HF ripple, polymer for bulk.	MLCC + polymer dominate at 0.8–1.8 V.
PEAK · NANOPLEX LDF default design choice	PEAK · NANOPLEX LDF tight cap tolerance	PEAK · NANOPLEX LDF pulsed-power tolerant	PEAK · NANOPLEX LDF 10–15 yr service life	FILM + POLYMER stacked roles	MINIATURIZATION point-of-load constraint

SUMMARY
NanoPlex LDF wins or competes at 5 of 6 positions — the four highest-voltage stages outright, plus the 48 V intermediate bus on TCO.

FIGURE 05 Position-by-position assessment of film vs. electrolytic capacitors in the 800 VDC architecture.

SPECIFICATIONS

CAPACITOR TYPES REQUIRED IN THE 800 VDC ARCHITECTURE

05

The DSX architecture creates demand for capacitors across multiple locations and timescales, from nanosecond-scale decoupling at the silicon level to second-scale bulk energy storage at the rack and facility level.

CAPACITOR TYPE	KEY SPECIFICATIONS	APPLICATION IN DSX
Metallized NanoPlex LDF · DC Link	800–1200 VDC · 100–4700 μF · low ESR/ESL · high ripple current	Primary 800 VDC bus filter & energy storage in rack power units and conversion stages
Metallized NanoPlex LDF · Snubber	400–1200 VDC · 0.1–10 μF · very fast rise time · low losses	Snubber networks across SiC/GaN switching devices in 800 VDC-to-GPU converters
Metallized NanoPlex LDF · AC Filter	480–900 VAC · X-rated · EMI suppression	Input EMI filtering at rectifier stage converting building AC to 800 VDC
NanoPlex LDF · Resonant LLC	600–1200 VDC · ±2% tolerance · high Q	Resonant tank capacitor in LLC converters in 800 VDC rack power units
Supercap / Hybrid Electrolytic-Film	2.7 V cells in series to 800 VDC · 100–400 J/unit	Fast-response bulk energy storage for sub-second GPU transient buffering
Ceramic (MLCC) · Board-Level	1–100 μF · 6–50 VDC · X7R / X5R	Point-of-load decoupling on GPU, CPU, and NVLink power rails
Aluminum Polymer · VRM Output	100–1000 μF · 6–16 VDC · ultra-low ESR	GPU and CPU voltage regulator module output filtering

TABLE 2 Capacitor types and specifications required by the NVIDIA DSX 800 VDC architecture

NanoPlex LDF appears at four of the seven positions: the four highest-value high-voltage applications in the architecture.

WHERE NANOPLEX LDF WINS

4 / 7 POSITIONS ARE FILM-REQUIRED

■ DC Link	■ Snubber	■ AC Filter	■ LLC Tank	☐ Supercap	☐ MLCC	☐ VRM Out

■ NanoPlex LDF qualified · film-required ☐ Other dielectric (ceramic / electrolytic / hybrid)

POSITION-BY-POSITION

WHERE NANOPLEX FITS

NanoPlex LDF owns the four high-value film positions: DC link, snubber, AC filter, and LLC resonant tank. These are every position where film capacitors are mission-critical.

POWER CONVERSION

06

POWER CONVERTERS AND INVERTERS IN THE DC DATA CENTER

The 800 VDC architecture creates a new topology of power conversion stages. Each stage requires specialized capacitors for filtering, energy storage, and transient suppression.

AC-DC RECTIFIERS: PERIMETER CONVERSION

AC-DC rectifiers sit at the facility edge and perform the heavy lifting of converting utility AC into 800 VDC for the backbone. They take medium-voltage AC (13.8 kV) and output regulated 800 VDC via solid-state transformers (MVSSTs) or industrial-grade power-factor-correction (PFC) rectifier modules, typically built in 100 kW to 1 MW building blocks.

A gigawatt-scale AI factory may have dozens to hundreds of rectifier modules concentrated in power halls at the facility perimeter. Critical capacitor requirements are MPPF AC filter capacitors on the input for EMI suppression and high-voltage DC bus filter capacitors on the output to smooth the rectified waveform.

DC-DC CONVERTERS: RACK-LEVEL STEP-DOWN

DC-DC converters sit inside or adjacent to each compute rack and step 800 VDC down to the 48 V or 12 V rails that GPUs and CPUs consume. The dominant topology is the LLC resonant converter, operating at significantly higher switching frequencies (100 kHz to 1 MHz) than the perimeter rectifiers.

A gigawatt-scale factory may contain thousands of these, each rated at 30–100 kW. LLC resonant tank capacitors must maintain ±2% capacitance tolerance and a high Q factor to keep the converter in its optimal soft-switching region. DC bus filter capacitors at the 800 V input must handle continuous high-frequency ripple current in ambient temperatures that routinely exceed 105 °C near GPU hot-spots.

BIDIRECTIONAL DC-DC AND ADDITIONAL CONVERTER TYPES

Bidirectional DC-DC converters manage charging and discharging of both rack-level capacitor energy storage banks (the EVA) and facility-level Battery Energy Storage Systems (BESS). They use topologies such as bidirectional buck-boost or dual-active-bridge to handle bidirectional power flow synchronized to GPU workload bursts.

The DSX architecture also specifies point-of-load (PoL) converters at the board level (48 V → 12 V/5 V, 1–10 kW); grid-tied inverters for BESS (800 VDC → 415 VAC, 1–10 MW); and solar/DG inverter interfaces (variable DC → 800 VDC, 500 kW–10 MW) integrating onsite generation into the 800 VDC bus.

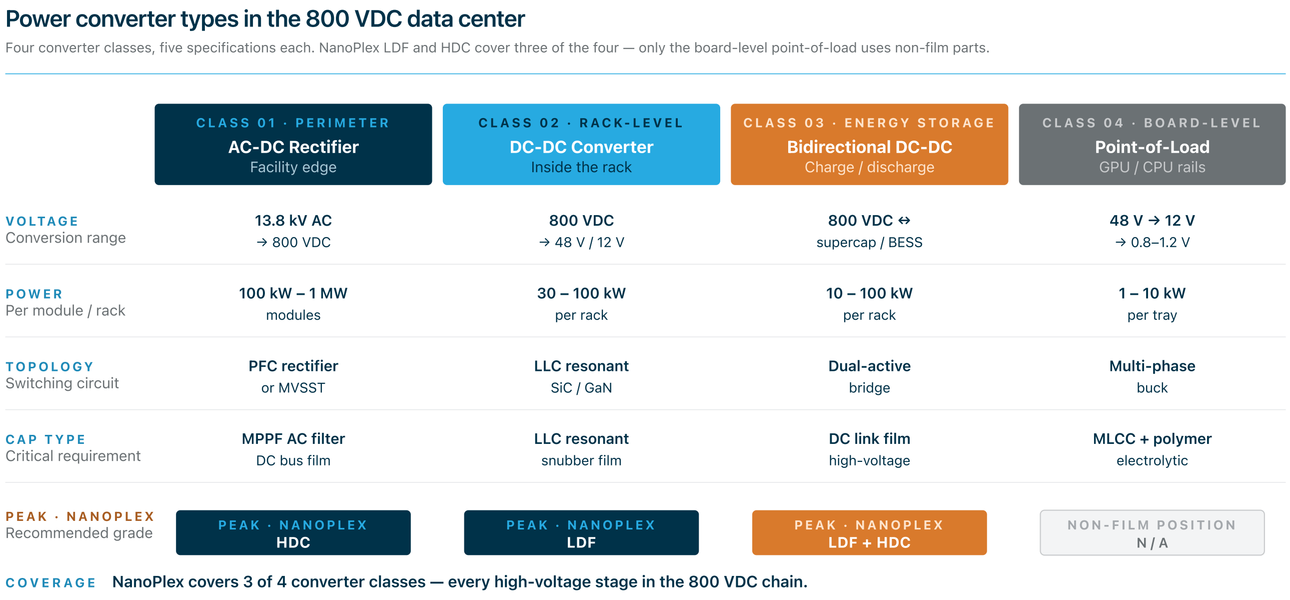
CONVERTER MAP BY POSITION

Each converter stage drives a distinct capacitor specification. Voltage, switching frequency, ripple current, and tolerance all shift across the chain.

CONVERTER TYPE	VOLTAGE	POWER RANGE	ROLE IN DSX	CRITICAL CAP REQUIREMENT
AC-to-800 VDC Rectifier/PFC	415 VAC → 800 VDC	100 kW – 1 MW	Building-level conversion	MPPF AC filter · DC bus film caps
800 VDC-to-48 VDC Isolated DC-DC	800 → 48 VDC	30 – 100 kW	Rack-level step-down	Snubber film · LLC resonant film caps
48-to-12/5 VDC Point-of-Load	48 → 12 → 5 VDC	1 – 10 kW	Board-level GPU/CPU rails	MLCC · aluminum polymer output caps
Bidirectional DC-DC (Charge Ctrl)	800 VDC ↔ supercap	10 – 100 kW	Rack energy storage mgmt	High-voltage MPPF DC link film caps
Grid-Tied Inverter (BESS)	800 VDC → 415 VAC	1 – 10 MW	BESS discharge to grid	High-power MPPF DC link · AC filter
Solar/DG Inverter Interface	Variable DC → 800 VDC	500 kW – 10 MW	Onsite generation integration	MPPF DC bus · SiC snubber caps

TABLE 3 Converter and inverter types with capacitor requirements in the 800 VDC architecture

NanoPlex LDF and HDC are the dielectric-film grades for every high-voltage position in this table.



Power converter types in the 800 VDC data center

Four converter classes, five specifications each. NanoPlex LDF and HDC cover three of the four — only the board-level point-of-load uses non-film parts.

	CLASS 01 · PERIMETER **AC-DC Rectifier** Facility edge	CLASS 02 · RACK-LEVEL **DC-DC Converter** Inside the rack	CLASS 03 · ENERGY STORAGE **Bidirectional DC-DC** Charge / discharge	CLASS 04 · BOARD-LEVEL **Point-of-Load** GPU / CPU rails
VOLTAGE Conversion range	**13.8 kV AC** → 800 VDC	**800 VDC** → 48 V / 12 V	**800 VDC ↔** supercap / BESS	**48 V → 12 V** → 0.8–1.2 V
POWER Per module / rack	**100 kW – 1 MW** modules	**30 – 100 kW** per rack	**10 – 100 kW** per rack	**1 – 10 kW** per tray
TOPOLOGY Switching circuit	**PFC rectifier** or MVSST	**LLC resonant** SiC / GaN	**Dual-active** bridge	**Multi-phase** buck
CAP TYPE Critical requirement	**MPPF AC filter** DC bus film	**LLC resonant** snubber film	**DC link film** high-voltage	**MLCC + polymer** electrolytic
PEAK · NANOPLEX Recommended grade	PEAK · NANOPLEX **HDC**	PEAK · NANOPLEX **LDF**	PEAK · NANOPLEX **LDF + HDC**	NON-FILM POSITION N / A

COVERAGE **NanoPlex covers 3 of 4 converter classes — every high-voltage stage in the 800 VDC chain.**

FIGURE 06 Power converter types, operating characteristics, and capacitor requirements.

NANOPLEX

HOW NANOPLEX LDF AND HDC SUPPORT THE DC DATA CENTER

07

Peak Nano’s NanoPlex LDF (Low Dissipation Factor) and HDC (High Dielectric Constant) films are nanocomposite dielectrics engineered specifically for the high-voltage, high-temperature, high-frequency conditions of 800 VDC data center power systems.

Manufactured in the United States using Peak Nano’s patented nanolayer coextrusion technology, these films represent a generational advance over conventional BOPP capacitor films.

PERFORMANCE ADVANTAGES OVER BOPP

Standard BOPP capacitor films were engineered for an earlier era of power electronics: IGBT-era switching speeds, lower voltages, and less demanding thermal environments. NanoPlex films are designed for the 800 VDC, SiC/GaN switching environment of the AI factory.

NanoPlex delivers up to 4× the energy density of standard BOPP film capacitors, with energy density approaching electrolytic. Its low dissipation factor means less self-heating, directly contributing to the DSX Max-Q token-per-watt optimization target. NanoPlex capacitors deliver up to 5× the service life, matching or exceeding the 10–15-year AI factory depreciation cycle.

NanoPlex film capacitors operate continuously at 135 °C, well above the 105 °C ceiling of conventional BOPP. That higher ceiling matters because 135 °C is the actual operating condition near GPU hot spots. In a high-power environment like the NVIDIA DSX architecture, the likelihood of thermal failure for BOPP-based capacitors is significantly higher than for NanoPlex.

> Up to 4× the energy density of standard BOPP, with a 135 °C ceiling vs. 105 °C.

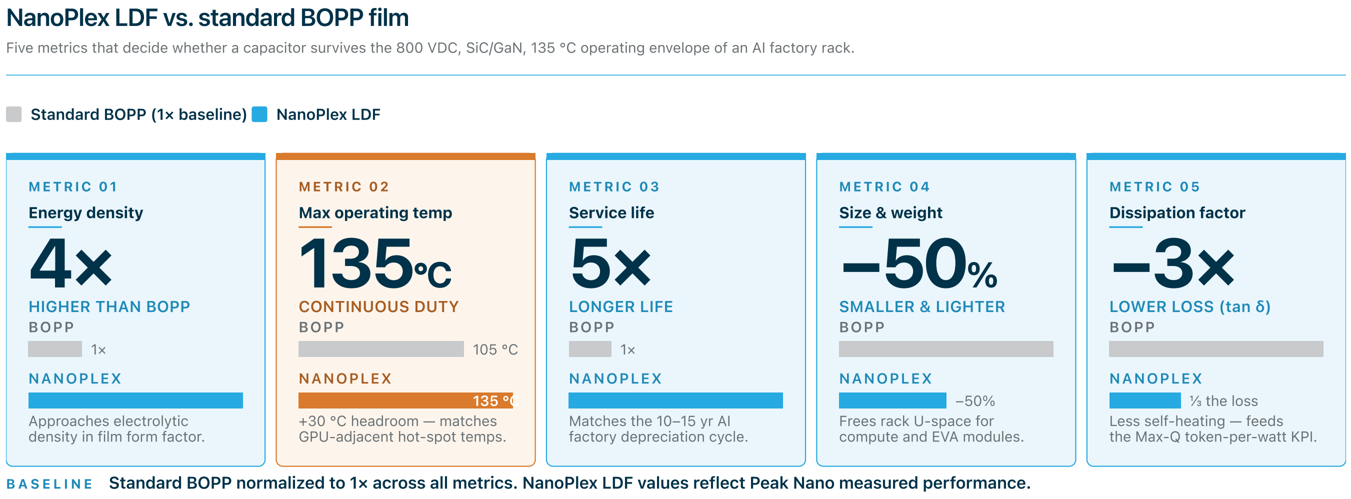


FIGURE 07 NanoPlex LDF performance advantages versus standard BOPP baseline.

NANOPLEX LDF: CONTINUOUS-DUTY DC APPLICATIONS

NanoPlex LDF is the primary film for the 800 VDC power chain. It provides the low dissipation factor, tight capacitance tolerance, and high ripple current capability required for the four highest-value capacitor positions in the DSX architecture: 800 VDC DC link capacitors in rack power units and perimeter rectifiers; LLC resonant tank capacitors in high-efficiency rack-level DC-DC converters; SiC/GaN snubber capacitors protecting high-speed switching devices; and rack-level energy storage capacitors in the Energy Variance Appliance at 400 J/GPU.

NANOPLEX HDC: HIGH-VOLTAGE AND PULSED-POWER

NanoPlex HDC is designed for applications requiring extreme voltage ratings and pulsed-power capability: busway protection and surge suppression modules operating at 800–1200 VDC continuous; BESS inverter DC link capacitors handling high-power bidirectional cycling; AC EMI filter capacitors at the rectifier input stage; and solar/distributed generation inverter interfaces integrating onsite power into the 800 VDC bus.

HDC's dielectric strength exceeding 600 V/µm eliminates the need to stack multiple lower-voltage film grades, a common limitation of BOPP-based designs.

NanoPlex LDF & HDC across the 800 VDC data center

Two grades, eight positions. LDF for continuous-duty DC; HDC for high-voltage and pulsed-power.
Together they replace every electrolytic and BOPP position above 48 V.

GRADE 01 · LOW DISSIPATION FACTOR

NanoPlex LDF — Continuous-duty DC positions

GRADE 02 · HIGH DIELECTRIC CONSTANT

NanoPlex HDC — High-voltage & pulsed-power positions

POSITION 01

800 V DC link capacitor

800–1200 VDC · low ESR

High ripple-current capability

RACK POWER UNITS · PERIMETER RECTIFIERS

POSITION 02

LLC resonant tank

±2% tolerance · high Q

Soft-switching 100 kHz–1 MHz

RACK-LEVEL DC-DC CONVERTERS

POSITION 03

SiC / GaN snubber

0.1–10 µF · >10,000 V/µs

Protects fast switching devices

WIDE-BANDGAP POWER STAGES

POSITION 04

Rack energy storage

400 J / GPU · supercap hybrid

Buffers transient compute bursts

ENERGY VARIANCE APPLIANCE (EVA)

POSITION 05

Busway protection

800–1200 VDC continuous

Surge & transient suppression

FACILITY DC BACKBONE

POSITION 06

BESS inverter DC link

High-power · pulsed duty

Bidirectional charge / discharge

GRID-TIED ENERGY STORAGE

POSITION 07

AC EMI filter

X-rated · 480–900 VAC

Conducted-emissions suppression

RECTIFIER INPUT STAGE

POSITION 08

Solar / DG inverter

Variable DC → 800 VDC

Onsite generation integration

ONSITE POWER INTERFACE

FIGURE 08 NanoPlex LDF and HDC application map across the 800 VDC data center.

07

SUPPLY CHAIN & VALUE

SUPPLY CHAIN SOVEREIGNTY AND VALUE PROPOSITION

SUPPLY CHAIN SOVEREIGNTY

Approximately 80% of global BOPP capacitor film production is concentrated in China. As data centers become critical national infrastructure for AI capabilities, this concentration creates an unacceptable supply chain vulnerability.

NanoPlex films are manufactured in the United States, directly addressing this risk. For data center operators, hyperscalers, and defense-adjacent AI infrastructure, a domestically manufactured, high-performance capacitor film is a supply chain imperative as well as a technical advantage.

WHY THIS MATTERS

80% CONCENTRATION RISK

Approximately 80% of global BOPP capacitor film production is in China. NanoPlex is U.S.-manufactured, which eliminates that dependency.

VALUE PROPOSITION BY CUSTOMER TYPE

TIER 1 CAPACITOR OEMS

A qualified 800 VDC DC link film in a single material grade with dielectric strength and tan δ performance that BOPP cannot match at real operating temperatures. (TDK, Vishay, Electronicon.)

POWER SUPPLY MANUFACTURERS

Hit the 800 VDC input spec without over-engineering the DC bus filter. Smaller, lighter, cooler-running capacitors. (Vicor, Delta, Murata.)

BUSWAY MANUFACTURERS

No electrolytic wear-out mechanism in a 15-year AI factory with guaranteed uptime SLAs. (Delta, Eaton, ABB, Schneider Electric.)

DATA CENTER OPERATORS

The value is maintenance cost and uptime, not spec-sheet numbers.

4×

ENERGY DENSITY VS. BOPP

And up to 5× service life. NanoPlex closes the gap film capacitors have always had vs. electrolytic.

MISSION CRITICAL

The move to DC data centers is not a speculative trend. It is an architectural inevitability driven by the physics of AI computing. GPU rack power densities have exceeded the scaling limits of AC distribution. NVIDIA's Vera Rubin DSX AI Factory reference design has established 800 VDC as the industry standard for AI infrastructure. Major power infrastructure vendors (Delta, Eaton, ABB, Schneider Electric) are already shipping 800 VDC busway products. And the Kyber rack platform arriving in 2027, requiring 600 kW to 1 MW per rack, will make 800 VDC distribution mandatory for any facility operating at scale.

Within this architecture, film capacitors are critical components. They ensure voltage quality at every stage of the power chain, absorb the large transients that synchronized GPU workloads create, and enable the high-frequency SiC/GaN power conversion stages that 800 VDC requires. NVIDIA specifies capacitors at the rack level for a reason: they are the technology that keeps AI online.

08

MISSION CRITICAL

Peak Nano's NanoPlex LDF and HDC nanocomposite dielectric films are engineered for these conditions. They deliver the energy density, temperature performance, dissipation factor, and service life that 800 VDC systems require, in a domestically manufactured material that eliminates dependence on Chinese BOPP supply chains. For capacitor OEMs, power electronics manufacturers, and data center operators designing for the next decade of AI infrastructure, NanoPlex is the film that enables the DC data center.

THREE THINGS TO REMEMBER

01

800 VDC is now the spec

NVIDIA Vera Rubin DSX has locked it in. Kyber racks at 1 MW in 2027 make any AC alternative non-viable at scale.

02

Film capacitors are mission-critical

Four positions in the DSX chain – DC link, snubber, AC filter, LLC tank – require film. Every position is a NanoPlex LDF fit.

03

NanoPlex eliminates supply risk

U.S.-manufactured. 4× the energy density and up to 5× the service life of BOPP – without the ~80% China concentration.

NEXT STEP

DESIGNING FOR THE 800 VDC AI FACTORY?

NanoPlex LDF and HDC films are qualified for the energy density, thermal endurance, and service life that NVIDIA DSX-class systems require. Request a sample kit, technical data package, or a meeting with our materials team.

REQUEST A SAMPLE KIT

SALES@PEAKNANO.COM · +1 949.922.7472