NANOPLEX

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SOLUTION BRIEF

NANOPLEX™ FILMS OPTIMIZE STEP-UP & STEP-DOWN POWER

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HIGH TEMP CAPACITORS FOR OPTIMIZED POWER TRANSMISSION

NANOPLEX FOR POWER TRANSMISSION

- NanoPlex based capacitors Provide temperate tolerance up to 135°C
- NanoPlex based capacitors are predicted to have 3-5X longer lifetimes than BOPP based capacitors
- NanoPlex based capacitors enable faster discharge with lower impedance, making power factoring moreefficient.
- Over 20 global patents for NanoPlex film technology.
- NanoPlex is 100% US-engineered and manufactured – no reliance on China.

NANO**PLEX**™

Step-up and Step-down Power Transmission

Step-up and step-down power transmission systems are the backbone of our modern electrical grid, enabling efficient long-distance electricity transmission. A step-up transformer increases the voltage from its primary (input) to its secondary (output) winding. A step-down transformer does the opposite, reducing the voltage from its primary to secondary winding. Its features include The significance of these systems, primarily powered by transformers, cannot be overstated. Today the growth of multiple power generation sources, renewable DC conversations, AI-driven market grids and other factors are driving new demand for higher frequency switching, higher temperate tolerances and to creating other challenges for the next generation of step-up and step-down power transmission. Below are some the major challenges:

Current Challenges for Step-Up and Step-Down Transmission

While highly efficient, transformers still experience energy losses during operation. These losses can be categorized into two main types:

- **Core (iron) losses / Hysteresis loss:** Energy lost due to the repeated magnetization and demagnetization of the core material.
- **Copper Losses (I^2R Losses):** Occurs in both primary and secondary windings due to the resistance of the copper wire.
- **Voltage Regulation Issues:** Voltage regulation refers to the ability of a trans former to maintain a constant voltage level at its output despite variations in load or input voltage.
- **Harmonics and Power Quality Concerns:** Harmonics are distortions in the sinusoidal waveform of voltage or current, often caused by non-linear loads. They can lead to several issues in transformer systems.
- **Integration of Renewable Energy Sources:** The increasing adoption of renewable energy sources poses several challenges for transformer systems. Renewable sources like solar and wind have variable output, requiring

These challenges underscore the continuous need for innovation and improvement in transformer technology. The evolving demands of modern power systems necessitate a proactive approach to enhancing transformer efficiency and reliability. This ongoing quest for improvement is a testament to the power industry's dynamism and resilience.

VOLTAGE INCREASE VS. VOLTAGE DECREASE

Step-up transformers increase voltage from 220v up to 11,000v or greater, while step-down transformers will decrease voltage from 220v to110v, 24v, 20v or lower.

APPLICATIONS AND USAGE

Step-up transformers are used to increase the voltage for better energy transmission. Step-down transformers take that voltage and reduce it to safer levels for use in household appliances, electronics and industrial equipment.

PRIMARY AND SECONDARY WINDING

In a step-up transformer, the primary winding has fewer turns, while the secondary winding has more turns. this configuration cuaese the voltage to increase.

The Role of NanoPlex Based Capacitor in Step-Up and Step-Down Power

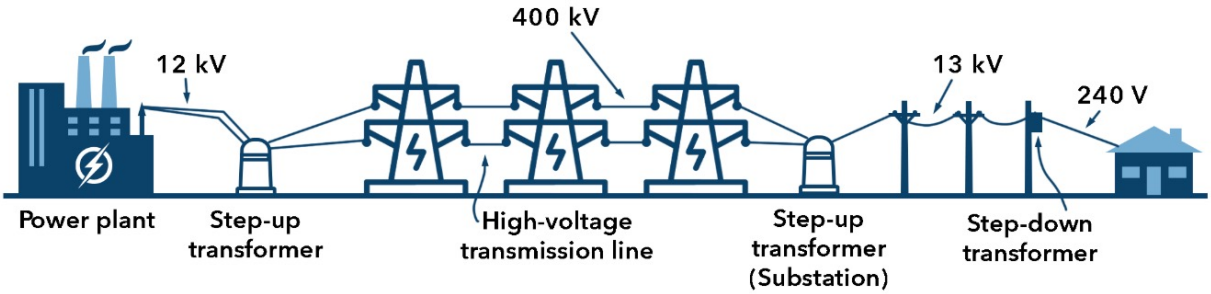
The high-energy capacitor market for the power grid is evolving rapidly to meet the challenges of renewable energy integration, smart grid deployment, and power quality management. Key trends include higher energy densities, improved temperature tolerance, longer lifetimes, and enhanced connectivity.

As switching frequencies increase and duty cycles become more demanding, capacitor designs adapt with lower parasitic and more robust constructions. New dielectric materials and manufacturing techniques enable capacitors to meet the stringent requirements of modern grid infrastructure. Capacitors play several vital roles in enhancing the efficiency of step-up and step-down transformer systems:

- **Power Factor Correction:** Capacitors are commonly used for power factor correction in transformer systems. By adding capacitors to the AC input leads of a transformer, the power factor can be improved, making the power transmission more efficient. This allows a higher percentage of real power to be transferred from the source to the load.
- **Voltage Regulation:** Capacitor banks can help stabilize voltage levels in transmission and distribution systems. This is particularly important for maintaining consistent voltage output from transformers.
- **Harmonic Filtering:** When combined with inductors, capacitors can form harmonic filters to mitigate harmonic distortion in power systems, helping improve overall power quality.
- **Energy Storage:** While not their primary role, capacitors can provide short-term energy storage to help stabilize power flow in transformer systems.
- **Reactive Power Compensation:** Capacitors can provide reactive power compensation, which helps reduce losses in the transmission system.
- **Inrush Current Mitigation:** Capacitors can help mitigate inrush currents when energizing transformers, which can be up to 16x greater when reverse-feeding transformers.
- **Efficiency Improvement:** By correcting power factors and providing reactive power compensation, capacitors help reduce overall system losses, thereby improving the efficiency of step-up and step-down transformer systems.

It's important to note that while capacitors can significantly enhance transformer efficiency, their use must be carefully designed and implemented to avoid potential issues such as voltage instability or resonance problems. The specific capacitor values and configurations will depend on the transformer system's operating conditions.

Step-up and Step-Down Power Transmission



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