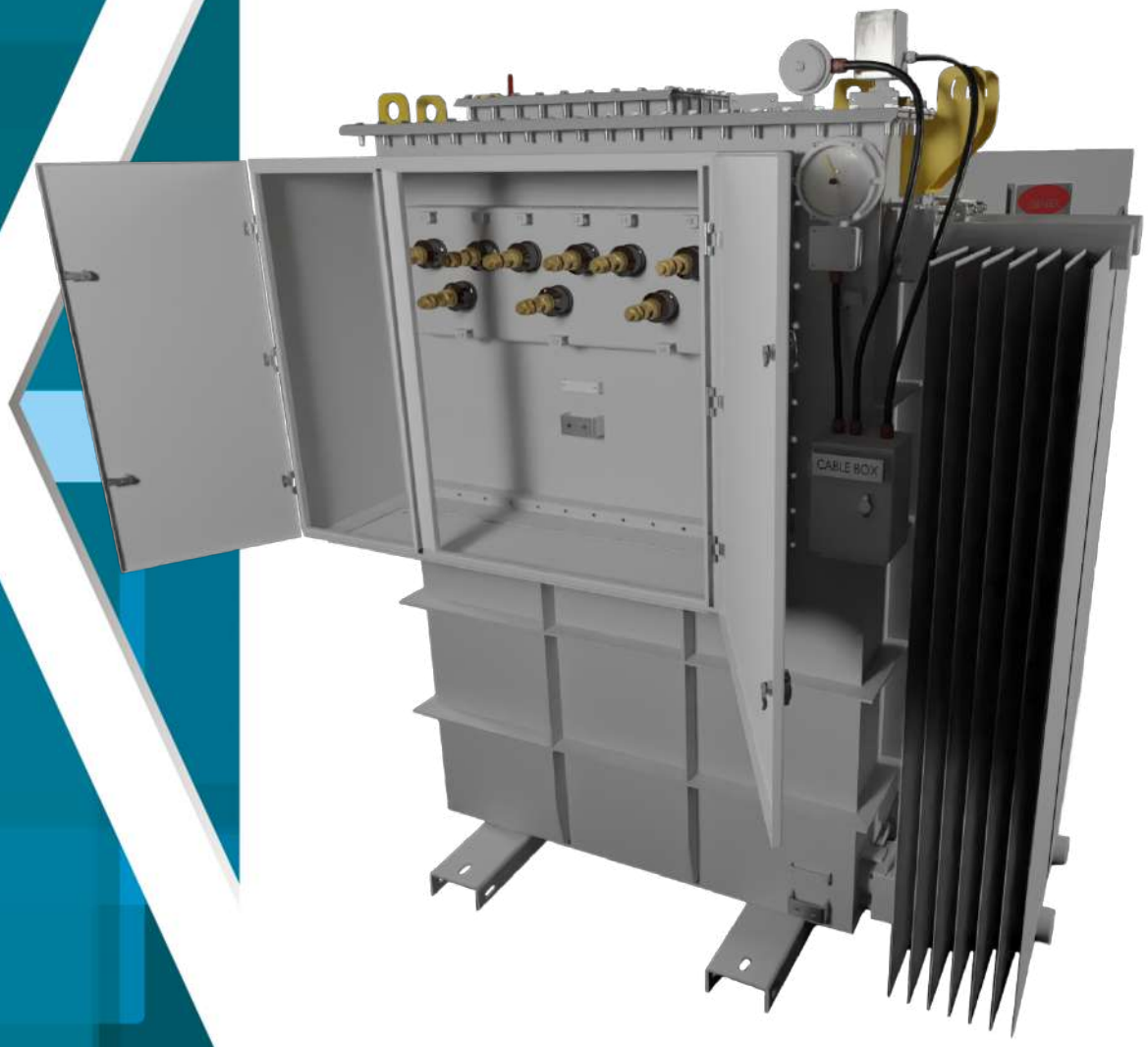
PHASE SHIFTING

TRANSFORMERS



DATSAN
SPECIAL TRANSFORMERS

Datsan Special Transformers, a well-established Turkish transformer company with over three decades of experience, provides a wide range of electrical services and solutions. Since its inception in 1992, we have earned a solid reputation as a trusted manufacturer, successfully completing numerous projects spanning various industries, including oil and gas, power distribution, marine, and heavy sectors. Our products distinguish themselves in the market, thanks to the expertise of our highly qualified R&D professionals, ensuring both reliability and innovation. With a customized approach for each project, Datsan Special Transformers comprehensively understands and fulfills our customers' requirements with optimal solutions. Throughout the years, we have consistently delivered cutting-edge technologies to both our esteemed customers and partners.

GENERAL INFORMATION

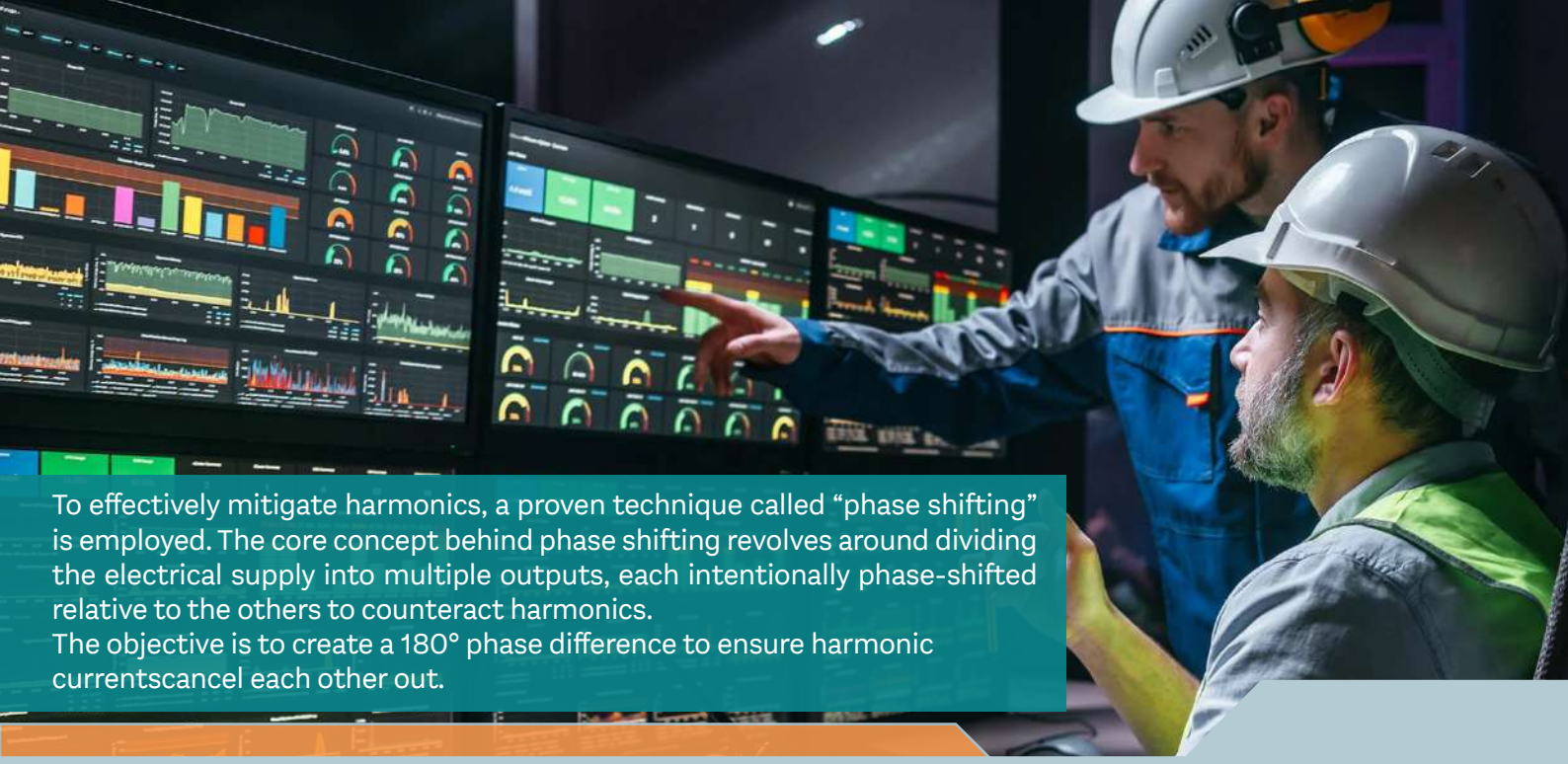
VALUES

- Innovation
- Creating novel solutions
- Nurturing a partnership-friendly environment
- Tailoring approaches to individual customers
- Upholding superior quality standards
- Maximizing technological effectiveness

MISSION

WE CREATE, KEEP AND TRANSMIT VICTORY TECHNOLOGIES FOR OUR PARTNERS

STANDARDS



To effectively mitigate harmonics, a proven technique called “phase shifting” is employed. The core concept behind phase shifting revolves around dividing the electrical supply into multiple outputs, each intentionally phase-shifted relative to the others to counteract harmonics.
The objective is to create a 180° phase difference to ensure harmonic currentscancel each other out.

ADDRESSING HARMONICS WITH PHASE SHIFTING

As an illustration:

A 60° angular displacement is necessary between two three-phase outputs to neutralize 3rd harmonic currents.
A 30° angular displacement suffices between two three-phase outputs to counteract 5th and 7th harmonic currents.
A 15° angular displacement is required between two three-phase outputs to mitigate 11th and 13th harmonic currents.

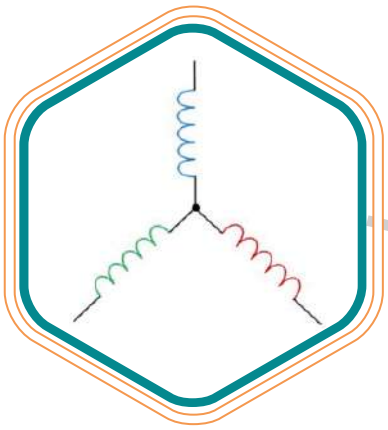
For example, when dealing with two variable-speed drives of similar specifications, installing a Delta Wye transformer (30° phase shift from the primary) on one drive and a delta-delta transformer (0° phase shift from the primary) on the other provides a 30° angular separation between the two outputs. By implementing phase shifting within the shared primary supply of both transformers, the 5th and 7th harmonic currents are effectively neutralized. This approach, involving phase-shifting non-linear loads, is employed to minimize the impact of specific harmonics.

DATSAN SPECIAL TRANSFORMERS is at the forefront of addressing harmonics and network harmonic effects in the oil and geothermal industries, specifically concerning Variable Speed Drives (VSDs) used in Electrical Submersible Pumps (ESPs). The company offers a range of phase-shifting transformers, including 12 pulse, 18 pulse, and 24 pulse variants, designed to meet the highest industry standards and provide tailored solutions to customers.

The primary challenge with VSDs is the generation of harmonics that can distort the power supply and affect the overall network quality. DATSAN's transformers excel in mitigating these harmonics by offering customizable solutions. Customers can specify their unique VSD harmonic spectrum and special requirements, allowing DATSAN to design transformers that precisely address their needs.

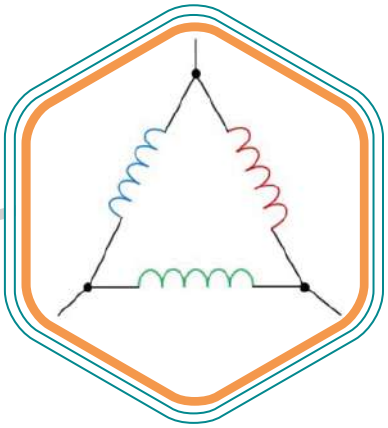
By putting cutting-edge technology in the hands of its customers, DATSAN empowers them to achieve operational excellence. Whether in the oil or geothermal industry, customized phase-shifting transformers from DATSAN SPECIAL TRANSFORMERS provide an optimum solution to enhance network quality, minimize downtime, and improve the overall efficiency of electrical submersible pump systems. DATSAN remains committed to supporting its customers in their pursuit of success and operational victory.

PHASE SHIFTING AND WINDING CONNECTIONS



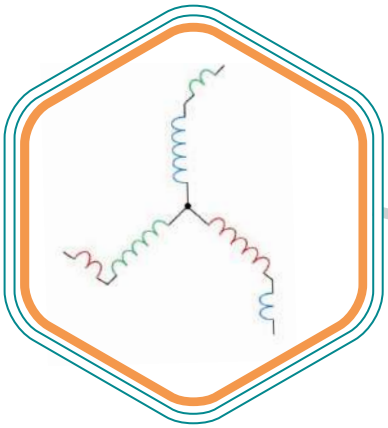
STAR(WYE)

Star or wye, denoted as ‘Y’ or ‘y’, connects the windings phase-to-neutral.



DELTA

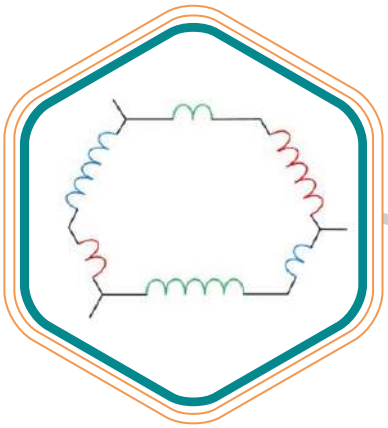
Delta-connected windings, indicated as ‘D’ or ‘d’, connect the windings phase-to-phase. In this conventional notation, uppercase letters signify windings with higher voltage, often referred to as ‘HV,’ while lowercase letters represent windings with lower voltage, known as ‘LV.’ These standard winding connections can achieve a phase shift of 30° or its multiples.



ZIG-ZAG

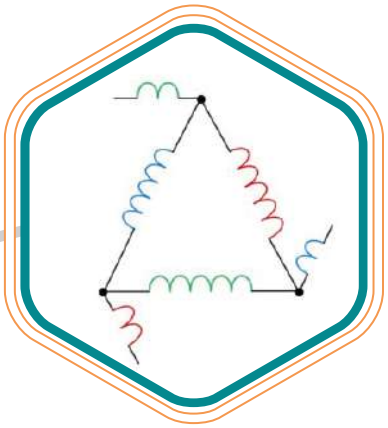
Zig-Zag (often denoted as ‘Z’ or ‘z’) is a modified star connection, with each phase composed of two magnetically connected phases. It is sometimes referred to as the “interconnected star.”

A phase shifting transformer eploys a complex winding arrangement to achieve the necessary angular displacement for each set of windings in a specific type of multi-pulse transformer.



POLYGON DELTA

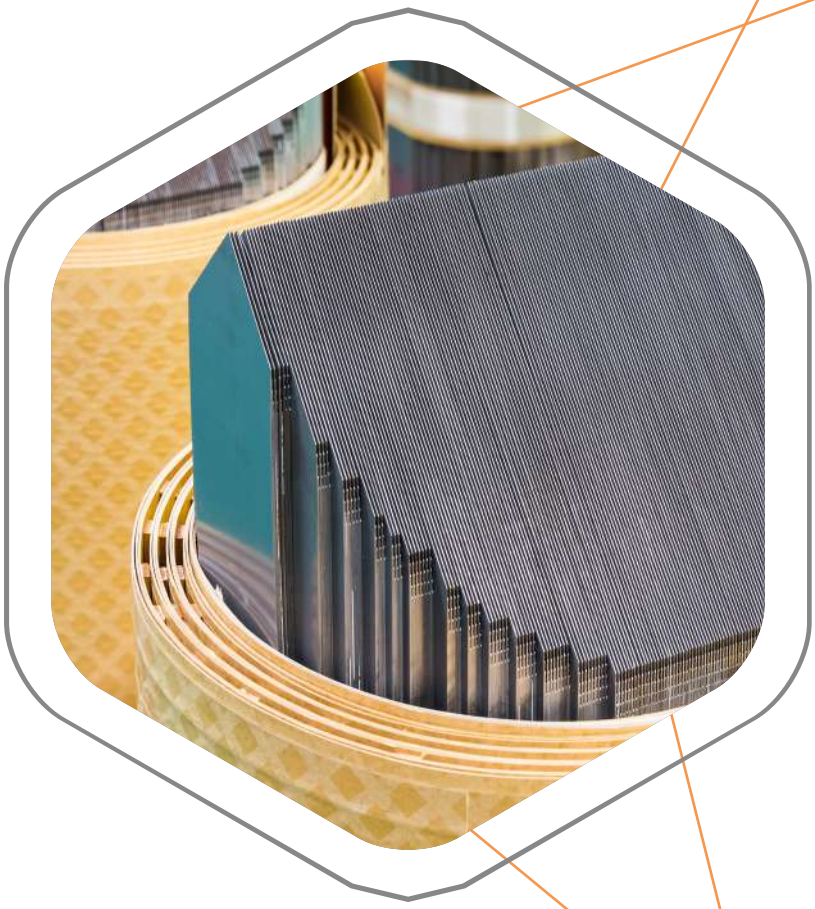
Polygon windings are characterized by a hexagonal form of voltage vectors. The notation is typically the same as extended delta, i.e., ‘d,’ with the displacement angle in brackets.



EXTENDED DELTA

Extended delta, along with polygon delta, are common winding configurations used to achieve phase displacements of less than 30 degrees. Notation typically follows that of delta, with the phase displacement added in brackets, e.g., d(-15°).

CORE, MAGNETIC CIRCUIT



Silicon sheets which used for production, purchased according to our design. We select our suppliers carefully from core loss guaranteed suppliers category with whom we are ready to build technical cooperation. Our designers are realized according to customer demand and standards with 0.23, 0.27 and 0.33mm thickness (M3, M4, M5) and grain oriented in magnetic field silicon sheets. We generally use core form for magnetic circuit. However we use shell type core form as well by customer request.

WINDINGS

The low voltage windings are usually made by flat section electrolytic copper. CTC copper are used for transformers rated power up to 1000kVA. Winding insulation are creating by craft or nomex. Cross section of the wires are calculating by special design softwares to reach higher level of cooling and lowest level of onload losses.

High voltage windings are generally made by enameled covered circular cross-section wire. Winding insulation is realized by craft and other special paper. Winding insulation is one of the most important point for the transformer life. Therefor we prefer best paper manufacturer in the world. Layer insulations made according to DIN 6740. Each coil is testing on after wiring process.

TEST AND QUALITY CONTROL

At Datsan Special Transformers' production line, we conduct routine tests in accordance with industry standards such as IEC 60076 or IEEE C57.12.90. Upon customer request, we also offer type and special tests.

During these tests, the results are instantly saved to our database and electronic portal system, all without the need for staff intervention. Our advanced software allows for real-time evaluation of encountered issues, often leading to quicker identification of error sources compared to manual checks.

For the convenience of our partners and customers, test reports can be accessed via our website. To do so, they simply need to contact our technical support department and request access to our online reporting and tracking system.

ROUTINE TESTS:

- Measuring of the winding resistance
- Measuring of the insulation resistance
- Measuring of the tum ratio
- Measuring of the short circuit impedance
- Measuring of the no-load and onload losses
- Induced voltage test
- Applied voltage test

TYPE TESTS:

- Temperature rise test
- Impulse voltage test
- Short circuit withstand test

SPECIAL TESTS:

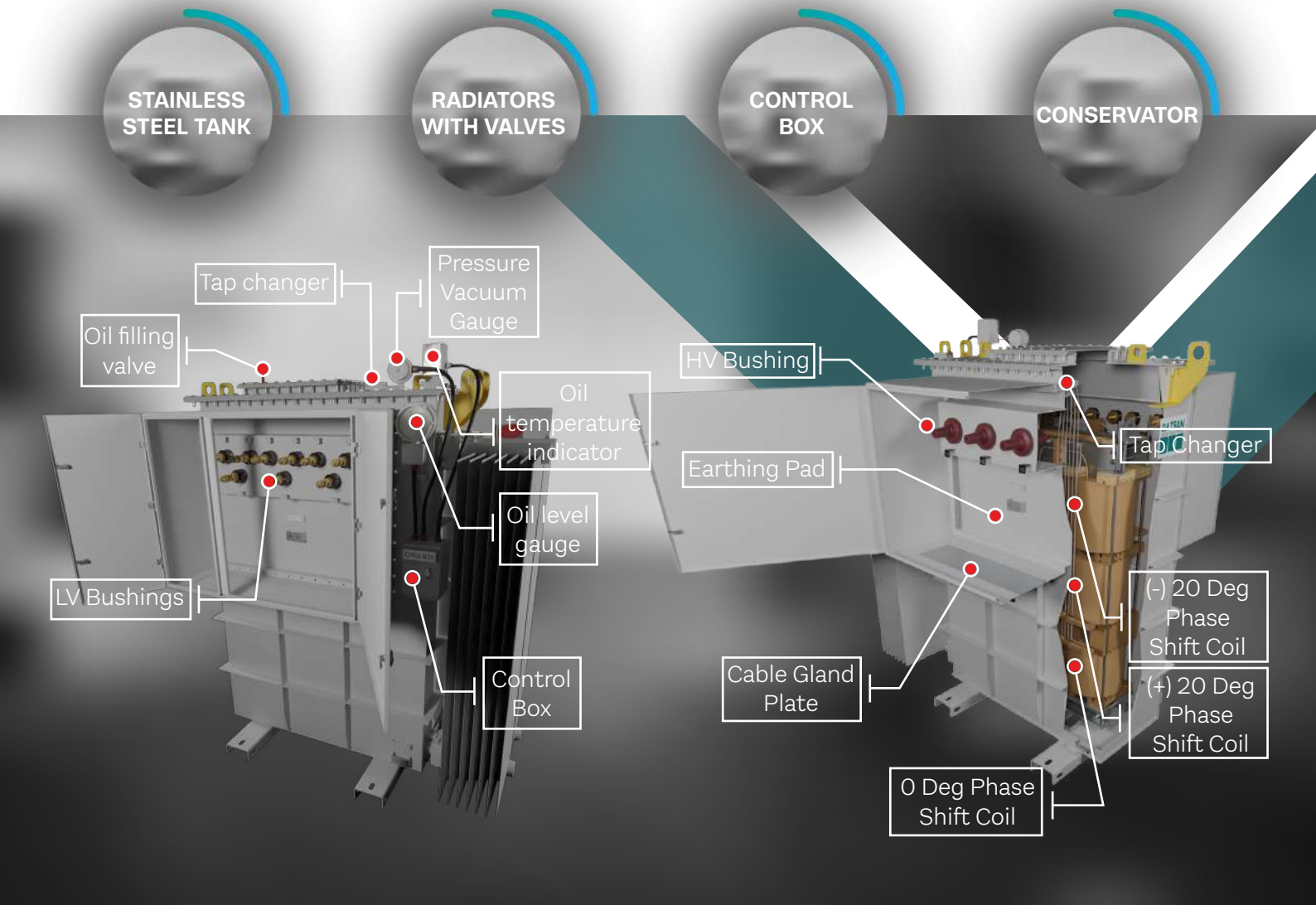
- Measuring of the noise level
- Measuring of the zero sequence i mpedance

CUSTOMIZE YOUR TRANSFORMER

KVA _ INPUT VOLT _ UPPER TAP CHANGER % _ LOWER TAP CHANGER % _ NO. OF OUTPUT VOLT x

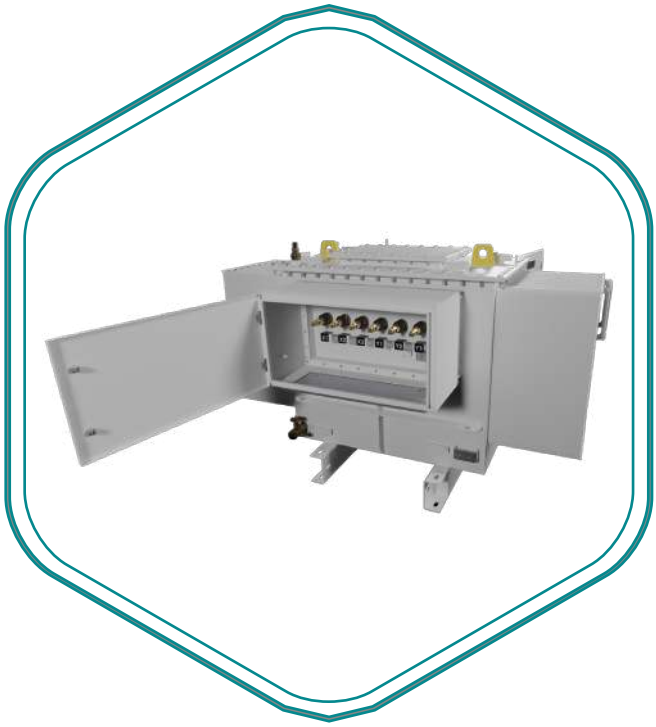
OUTPUT VOLT _ FREQUENCY _ COND _ TEMP _ K FACTOR _ TRIATERY KVA _ TRIATERY VOLTAGE

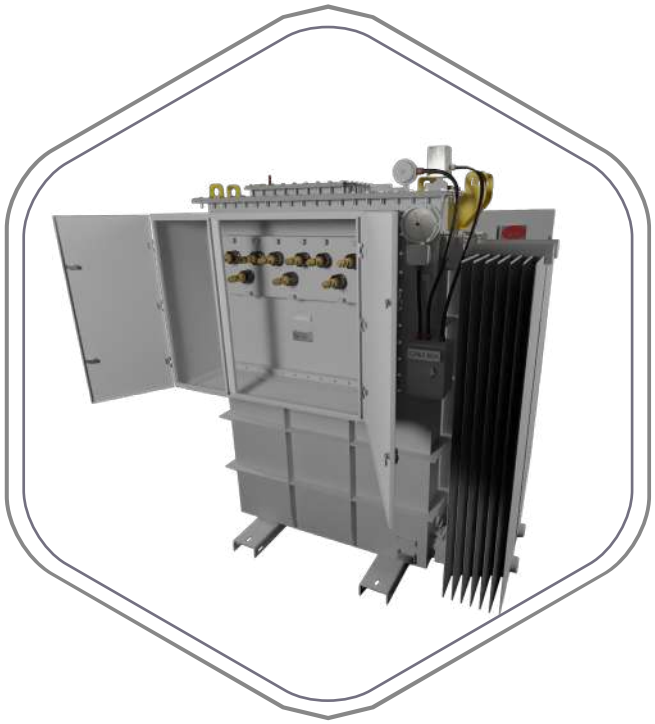
KVA	SELECT ANY KVA FROM 10 KV TO 10000 KVA
INPUT VOLT	SELECT ANY INPUT VOLTAGE AS PER YOU SYSTEM [
UPPER TAP CHANGER %	REQUIREMENT
LOWER TAP CHANGER %	SELECT THE NEEDED UPPER TAP CHANGER PERCENTAGE
NO. OF OUTPUT VOLT	SELECT THE NEEDED LOWER TAP CHANGER PERCENTAGE
OUTPUT VOLT	FOR 12 PULSE 2, FOR 18 PULSE 3, AND FOR 24 PULSE 4
FREQUENCY	SELECT THE OUTPUT WINDING VOLTAGE
COND	SELECT THE NETWORK OPERATING FREQUENCY
TEMP	SELECT THE WINDING CONDUCTOR COPPER OR ALUMINI-
K FACTOR	SPECIFY THE MAX. OPERATION AMBIENT TEMPERATURE
TRIATERY KVA	K FACTOR 1, 4, 9, 13, 20
TRIATERY VOLTAGE	SELECT THE NEEDED UTILITY OUTPUT KVA (IF NEEDED)
SPECIFY PROTECTION	SELECT THE NEEDED UTILITY WINDING VOLTAGE (IF NEEDED)
DEGREE	NEMA 1 / NEMA 3R / NEMA 4 / NEMA 4X / NEMA 4X SS
TANK MATERIAL	CARBON STEEL / SAINLESS STEEL / GALVANIZED
COOLING SYSTEM	FINS / WELDED RADIATORS / RADIATORS WITH VALVE
COLOUR	AS PER CUSTOMER REQUEST



12 PULSE

While 12-pulse transformers can demonstrate effectiveness when correctly configured, this system is notably vulnerable to voltage imbalances and tends to exhibit subpar performance at low load levels. Additionally, they often yield high Total Harmonic Distortion (THD) levels, failing to meet the IEEE 519 standards at the point of common coupling. 12-pulse transformers can incur costs approximately 25% higher than standard transformers. However, they do offer significantly improved performance, typically boasting lower THD levels around 7-8%. In light of these drawbacks and cost considerations, 12-pulse transformers are generally not regarded as the most suitable solution for your harmonic mitigation requirements.



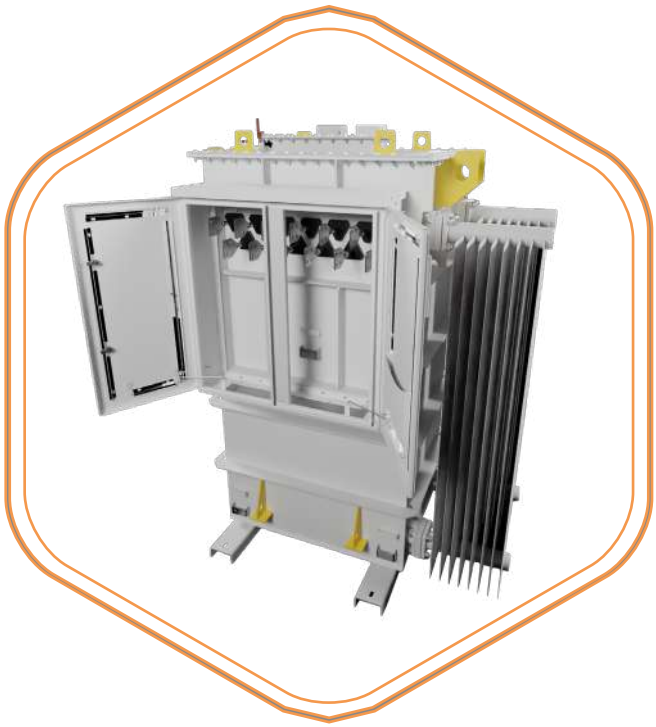


18 PULSE

18-pulse Transformers can exhibit significant effectiveness; however, they exhibit high sensitivity to voltage imbalances and tend to underperform at lower load levels. It's important to note that 18-pulse Transformers provide very good harmonic mitigation and can achieve THD levels of less than 5% meeting the requirement of IEEE 519. Nevertheless, it's worth mentioning that 18-pulse Transformers come at a cost approximately 45% higher than the 6-pulse Transformers. Given this price differential, 18-pulse Transformers are effective, but are not typically economical for smaller horsepower applications, so this method of harmonic mitigation is greatly recommended for applications with horsepower loads more than 150 hp.

24 PULSE

24-pulse transformers can yield substantial harmonic mitigation but are sensitive to the voltage imbalances and tend to be less efficient at lighter loads. It's crucial to highlight that the 24-pulse transformer, achieves remarkable harmonic reduction with a THD of 2.9% or less at the point of common coupling, aligning with IEEE 519 standards. However, their cost is approximately 65% higher compared to 6-pulse transformers. Consequently, 24-pulse transformers prove most cost-effective for applications requiring over 400 hp, balancing their enhanced performance against the higher upfront investment.



ACCESSORIES

OIL TEMPERATURE GAUGE
WITH/WITHOUT CONTACTS

WINDING TEMPERATURE GAUGE
WITH/WITHOUT CONTACTS

OIL LEVEL GAUGE
WITH/WITHOUT CONTACTS

PRESSURE VACUUM GAUGE
WITH/WITHOUT CONTACTS

PRESSURE RELIEVE VALVE

OIL FILLING PLUG

OIL DRAIN VALVE

SURGE ARRESTOR

SILICA GEL BREATHER

LIFTING JACK

Please contact with our team for any special accessories or requirements.

AFTER SALES SERVICE

01

Worldwide reach through Regional Service Centers across continents

02

Round-the-clock service and advisory support

03

Leverage DATSAN portal for Service, NCR, and warranty assistance

04

Rely on our experienced team for top-notch application services

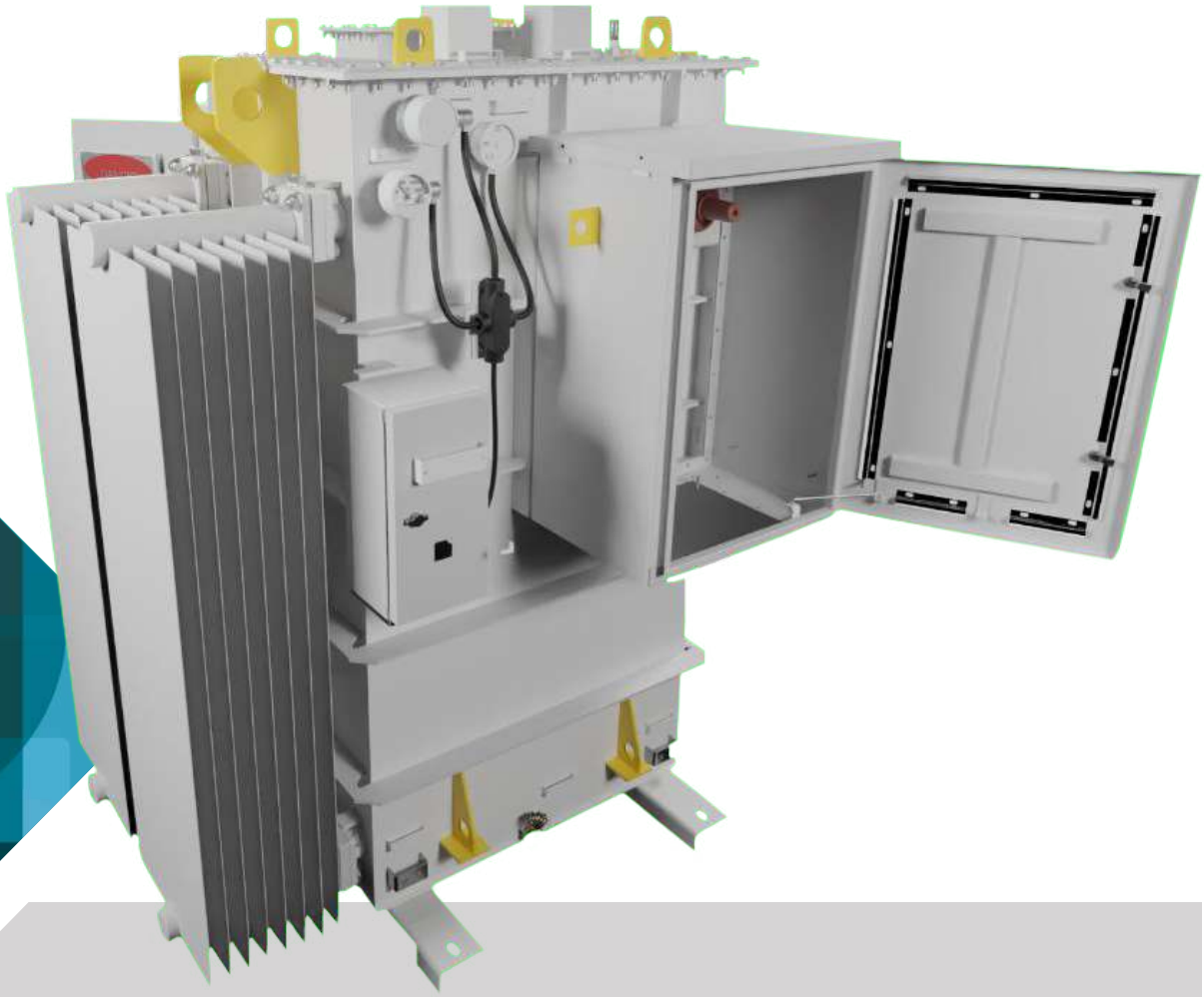
Have you ever encountered an issue while using a platform that demands an immediate solution? You reach out to technical support, but it's either too late or too early, and there's no response. Such a situation is unlikely to occur when you're working with Datsan Special Transformers support. We're available 24/7, serving clients worldwide, and there's never a language barrier hindering us from comprehending and promptly resolving your problems.

Datsan Special Transformers, in collaboration with partners globally, offers highly professional, multilingual support. In the rare event that your inquiry goes unanswered for 3 hours, you can effortlessly request a complimentary repair for your transformer.

Encountering an issue? Give us a call; you're never on your own.

AFTER SALES SERVICE

DATSAN
SPECIAL TRANSFORMERS



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