

Air core reactors

Nokian Capacitors manufactures dry-type air-core series reactors, damping and filter reactors to be used in conjunction with capacitor banks. Reactors are also manufactured for other applications. Reactors are designed using very latest technology and require little maintenance and are easy to install.





Damping reactors for capacitor banks

The transient switching and inrush currents of a shunt capacitor bank can be limited by a damping reactor connected in series with the bank. Damping reactors are comparable to series reactors with low reactances. Their voltage strength requirements, however, are often higher than those of series reactors. Our damping reactors are used all over the world in various environmental conditions.

Filter reactors

The filter has two functions, namely to produce capacitive reactive power at basic frequency and to filter out harmonics. A harmonic filter is designed to have a small impedance between phase and earth or between the phases at required harmonic frequency. Therefore the harmonic current will flow into the filter and not into the network. Normally each required harmonic frequency has a separate filter circuit. For higher harmonic frequencies a wide-band filter is used. We manufacture filter reactors and capacitors according to the customer's specification. Our filter reactors may be equipped with off-load tappings to make an accurate tuning possible at required frequency. Regulation is to meet the customer's demands.



Shunt reactors

Shunt reactors are used to compensate for capacitive reactive power generated by long lightly loaded transmission lines. Shunt reactors are switched on/off by breakers and are normally connected to the tertiary winding of the main transformer. Reactors are available up to 36 kV voltage level and 100 MVA power.

Current limited reactors

Current-limiting reactors are mainly used to limit short-circuit current, i.e. to prevent fault currents from rising to values dangerous for the equipment. Normal types of breakers, cables and equipment can thus be used instead of those with higher short-circuit power rating. This means savings in money. The voltage drop is determined practically only by the reactance of a series reactor, and it can be stated

$$u = U_p / U_p \times 100\% = X_{plp} \times 100 \% / U_p$$

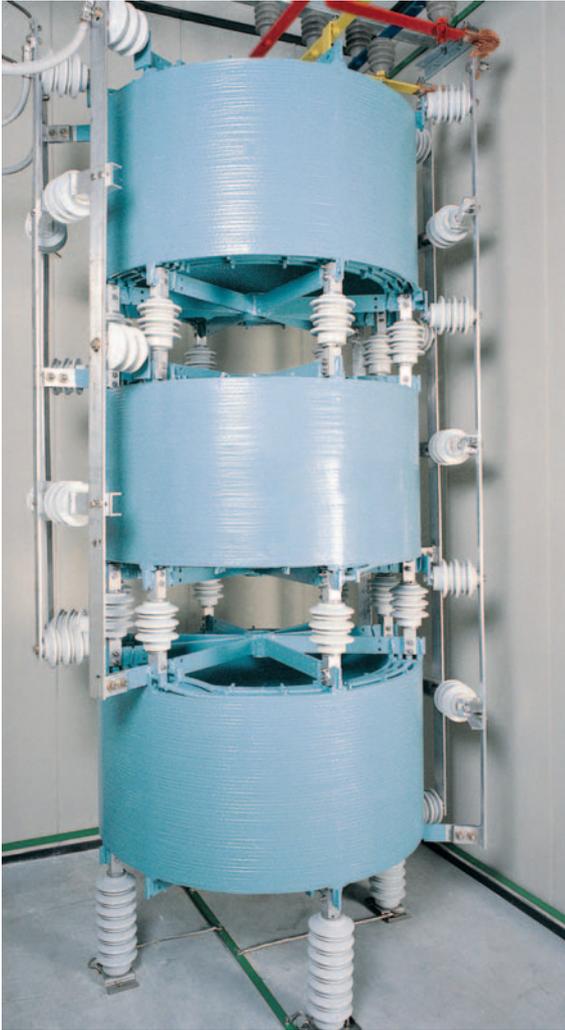
u = relative voltage drop, %
 ΔU_p = voltage drop in reactor, V
 U_p = line-to-neutral voltage, V
 I_p = current, A
 X_p = phase reactance of the reactor, ohm

When the short-circuit power before and after the reactor is known, the reactance can be calculated as follows

$$X_p = U^2 \times (1/S_{k2} - 1/S_{k1})$$

X_p = rated inductive reactance at a specific frequency f , ohm
 U = line-to-line voltage, kV
 S_{k1} = symmetrical 3-phase short-circuit power before the reactor, MVA
 S_{k2} = short-circuit power after the reactor, MVA





A series reactor consists of three phase coils, generally placed one on top of another with support insulators between them. The support insulators provide enough space between phases to ensure that the mutual inductance between the coils is negligible compared to the main inductance. In making the concrete foundations, closed loops in the reinforcement steel must be avoided. The magnetic clearances to metal constructions are normally given in our reactor specification.

Thyristor controlled reactors

Thyristor controlled reactors, called TCR-reactors, are used in Static var compensation systems. TCR-reactors are similar to the shunt reactors, but the current is continuously controlled by thyristor valves. The three phase reactor is delta connected. Each phase reactor is split into two coils and the thyristors are connected between the coils. TCR-reactors are available up to 36 kV and up to 180 MVA power.

Neutral-earthing reactors

A neutral-earthing reactor is connected between the neutral point of a three-phase system and earth. Its purpose is to limit the line-to-earth current of a directly earthed network or to reduce the line-to-earth current of an insulated line to a value suitable for protection.



Introduction

Nokian Capacitors has manufactured capacitors for reactive power compensation since 1956 and reactors for more than 40 years. Using our R&D and experience in high voltage technology we can provide a wide range of compensation equipment for power systems, including reactors for various purposes. We use sophisticated computer programs in designing the reactors, e.g. in order to provide a uniform current distribution and to determine the minimum clearances between reactors and other equipment. Through computer-aided product design highest reliability is achieved in construction, installation and operation.

Tests

All reactors are tested according to the relevant standards requiring the following routine and type tests. In addition we have made special short-circuit current withstand tests for some of our reactors at KEMA laboratories, in the Netherlands.

- Measurement of winding resistance
- Measurement of inductance
- Impulse voltage withstand test or discharge test with D.C charged capacitor bank
- Temperature-rise test (type test)
- Measurement of loss and quality factors at fundamental and at higher frequencies (type test)
- Further tests on agreement

Technical information

- Dry-insulated, air-cooled, air-core reactor for indoor or outdoor installation
- Single-phase or three-phase reactor
- Aluminum conductor
- Aluminum flat terminals (according to DIN 43673)
- Support insulators
- Reactors with or without off-load tappings
- Tolerance of rated inductance is for filter reactors $\pm 3\%$, and for damping, series and neutral-earthing reactors $-0/+20\%$, or according to the relevant standard or specifications
- Class of temperature range B (130°C) or F (155°C)
- Ambient temperature range $-40^{\circ}\text{C}/+40^{\circ}\text{C}$ and on request also max $+55^{\circ}\text{C}$
- Cooling method: AN (air-natural)

- Standards: IEC 289/VDE 0532 or other on request
- Color: pastel blue RAL 5024
- Insulation of the winding: enamelled wire or polyester film insulation, cycloaliphatic epoxy resin reinforced with fiberglass, painted with insulating varnish.

The painting/impregnation method developed by Nokian Capacitors ensures high mechanical and electrical strength for the coils even under extreme weather conditions. Flexible methods of production and computer-aided product design enable every reactor to be dimensioned individually for its purposes. Therefore we can take into account all space restrictions specified by the customer.

In line with our policy of on-going product development we reserve the right to alter specifications.