

## Training 2023

# ZRXC triangle

The "Z", "R", and "XC" triangle in electronics refers to the relationship between impedance (Z), resistance (R), and reactance (XC) in an AC circuit. Impedance is the overall opposition to the flow of alternating current, and it takes into account both resistance and reactance. The triangle helps visualize how these three components are related in a complex circuit.

The formula to calculate impedance (Z) in an AC circuit is given by:

$$Z = \sqrt{R^2 + XC^2}$$

Where:

- Z is the impedance in ohms
- R is the resistance in ohms
- XC is the capacitive reactance in ohms (use a negative sign if dealing with capacitors)

To calculate each side of the triangle:

1. Given the values of resistance (R) and capacitive reactance (XC), you can calculate impedance (Z) using the formula above.
2. Given impedance (Z) and resistance (R), you can rearrange the formula to solve for XC:

$$XC = \sqrt{Z^2 - R^2}$$

3. Given impedance (Z) and capacitive reactance (XC), you can rearrange the formula to solve for resistance:

$$R = \sqrt{Z^2 - XC^2}$$

In summary, the "Z", "R", and "XC" triangle helps you understand the relationships between these components in AC circuits and allows you to calculate any of the sides if the other two sides are known. Remember that impedance accounts for both resistance and reactance, and the angle between them (phase angle) is important in complex circuits.

## Winding phase to phase resistance & inductance of the traction motors formula

R - resistance

L 1,2,3 - phase U, W, V

$$(RL\_max - RL\_min) / ((RL1+RL2+RL3) \times 3) \times 100$$


### Accepted parameters:

R < 5% (mili-ohmmeter)

L < 1% (RLC meter)

## Dielectric Absorption Ratio

- Set measuring intervals to 15 - 60 sec

DAR > 1.15 

DAR = 1 (wet insulation)

DAR >= 1.7 (dry insulation)

## Shorted IGBT (PWR) check

+ - / - + between the transistors

+ - / - + to earth

> 4-5 kOhm

## Traction motors insulation test

- Set voltage to 2000-4000 V

R > 2 mOhm 

R > 1 mOhm (still acceptable)