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Voltage change
Information for design state

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Short-circuit voltage and voltage change

Short-circuit voltage (u_z)

Short-circuit voltage u_z signifies the voltage at nominal frequency which must be applied to the primary side of the transformer in order that the nominal current Ir flows with the secondary side short-circuited. Nominal short-circuit voltage is generally stated in percent of nominal voltage Ur of the winding to which the voltage is applied.

$$u_z = \frac{U_z}{U_r} * 100\%$$

F 1: Uz in V; Ur in V; uz in%

At part load, the short-circuit voltage changes proportionally to transformer load.

$$u_z(S) = u_z \frac{S}{S_r}$$

F 2: S in kVA; Sr in kVA; uz in%

Short-circuit voltage is composed of Ohmic voltage drop (U_R, u_R) and inductive leakage reactance voltage (U_x,u_x).

$$u_R = \frac{P_k}{S_r} * 100\%$$

F 3: Ohmic voltage drop; Pk in kW; Sr in kVA; ur in %

$$u_x = \sqrt{u_z^2 - u_R^2}$$

F 4: leakage reactance voltage; ur in %; ux in %; uz in %

Voltage change

The voltage Change between no-load and a symmetrical load of any magnitude at any cos ϕ can be calculated from nominal short-circuit voltage and the short-circuit losses at nominal load. It is referred to as uϕ and is also referred to as nominal voltage. The following applies for a particular part load a = S/Sr and a particular cos ϕ:

$$u_\phi = a * u'_\phi + \frac{1}{2} * \frac{(a * u''_\phi)^2}{10^2} + \frac{1}{8} * \frac{(a * u''_\phi)^4}{10^6}$$

with:

$$u'_\phi = u_R * \cos\phi + u_x * \sin\phi$$
$$u''_\phi = u_R * \sin\phi - u_x * \cos\phi$$

F 5: ur in %; ux in %; uφ in %; u'φ in %; u''φ in %