Important Symmetric Components Formulas PDF

Formulas
Examples
with Units

List of 27
Important Symmetric Components Formulas

1) Line Sequence Impedance Formulas

1.1) Fault Impedance using A-Phase Current Formula

Evaluate Formula

Formula

$$Z_{f(line)} = \frac{V_{1(line)} + V_{2(line)} + V_{0(line)}}{I_{a(line)}}$$

Example with Units

$$7.8313\,\Omega = \frac{13.51\,\text{V} + 16.056\,\text{V} + 17.5\,\text{V}}{6.01\,\text{A}}$$

1.2) Fault Impedance using Positive Sequence Current Formula

Evaluate Formula

Formula

$$Z_{f(line)} = \frac{V_{1(line)} + V_{2(line)} + V_{0(line)}}{3 \cdot I_{1(line)}}$$

Example with Units

$$7.84\,\Omega = \frac{13.51\,\text{V} + 16.056\,\text{V} + 17.5\,\text{V}}{3 \cdot 2.0011\,\text{A}}$$

1.3) Negative Sequence Impedance for Delta Connected Load Formula

Evaluate Formula

Formula

$$Z_{2(line)} = \frac{V_{2(line)}}{I_{2(line)}}$$

Example with Units

$$-44.4765\,\Omega = \frac{16.056\,\text{V}}{-0.361\,\text{A}}$$

1.4) Positive Sequence Impedance for Delta Connected Load Formula

Evaluate Formula

Formula

$$Z_{1(line)} = \frac{V_{1(line)}}{I_{1(line)}}$$

Example with Units

$$6.7513\,\Omega = \frac{13.51\,\text{V}}{2.0011\,\text{A}}$$

1.5) Sequence Impedance Formula

Evaluate Formula

Formula

$$Z_{s(line)} = \frac{V_{s(line)}}{I_{s(line)}}$$

Example with Units

$$1.75\,\Omega = \frac{7\,\text{V}}{4\,\text{A}}$$

1.6) Zero Sequence Impedance for Delta Connected Load Formula

Evaluate Formula

Formula

$$Z_{0D(line)} = \frac{V_{0(line)}}{I_{0(line)}}$$

Example with Units

$$7.9545\,\Omega = \frac{17.5\,V}{2.20\,A}$$

1.7) Zero Sequence Impedance for Star Connected Load Formula

Evaluate Formula

Formula

$$Z_{0S(line)} = Z_{s(line)} + \left(3 \cdot Z_{f(line)}\right)$$

Example with Units

$$25.271\,\Omega = 1.751\,\Omega + \left(3 \cdot 7.84\,\Omega\right)$$

2) Sequence Current & Voltage Formulas

2.1) Negative Phase Current for Delta Connected Load Formula

Evaluate Formula

Formula

$$I_2 = \frac{3 \cdot V_2}{Z_d}$$

Example with Units

$$-0.4667\,A = \frac{3 \cdot -1.4\,V}{9\,\Omega}$$

2.2) Negative Sequence Current for Star Connected Load Formula

Evaluate Formula

Formula

$$I_2 = \frac{V_2}{Z_y}$$

Example with Units

$$-0.3398\,A = \frac{-1.4\,V}{4.12\,\Omega}$$

2.3) Negative Sequence Voltage for Delta Connected Load Formula

Evaluate Formula

Formula

$$V_2 = \frac{Z_d \cdot I_2}{3}$$

Example with Units

$$-1.38\,V = \frac{9\,\Omega \cdot -0.46\,A}{3}$$

2.4) Negative Sequence Voltage for Star Connected Load Formula

Evaluate Formula

Formula

$$V_2 = I_2 \cdot Z_y$$

Example with Units

$$-1.8952\,V = -0.46\,A \cdot 4.12\,\Omega$$

2.5) Positive Sequence Current for Delta Connected Load Formula

Evaluate Formula

Formula

$$I_1 = \frac{3 \cdot V_1}{Z_d}$$

Example with Units

$$2\,A = \frac{3 \cdot 6\,V}{9\,\Omega}$$

2.6) Positive Sequence Current for Star Connected Load Formula

Evaluate Formula

Formula

$$I_1 = \frac{V_1}{Z_y}$$

Example with Units

$$1.4563\,\text{A} = \frac{6\,\text{V}}{4.12\,\Omega}$$

2.7) Positive Sequence Voltage for Delta Connected Load Formula

Evaluate Formula

Formula

$$V_1 = \frac{Z_d \cdot I_1}{3}$$

Example with Units

$$6\,\text{V} = \frac{9\,\Omega \cdot 2\,\text{A}}{3}$$

2.8) Positive Sequence Voltage for Star Connected Load Formula

Evaluate Formula

Formula

$$V_1 = Z_y \cdot I_1$$

Example with Units

$$8.24\,\text{V} = 4.12\,\Omega \cdot 2\,\text{A}$$

2.9) Symmetric Component Current using Sequence Impedance Formula

Evaluate Formula

Formula

$$I_s = \frac{V_s}{Z_s}$$

Example with Units

$$4.0057\,\text{A} = \frac{7.01\,\text{V}}{1.75\,\Omega}$$

2.10) Symmetric Component Voltage using Sequence Impedance Formula

Evaluate Formula

Formula

$$V_s = I_s \cdot Z_s$$

Example with Units

$$7.0175\,\text{V} = 4.01\,\text{A} \cdot 1.75\,\Omega$$

2.11) Zero Sequence Current for Star Connected Load Formula

Evaluate Formula

Formula

$$I_0 = \frac{V_0}{Z_y + \left(3 \cdot Z_f\right)}$$

Example with Units

$$2.1874\,\text{A} = \frac{60.59\,\text{V}}{4.12\,\Omega + \left(3 \cdot 7.86\,\Omega\right)}$$

2.12) Zero Sequence Voltage for Star Connected Load Formula

Evaluate Formula

Formula

$$V_0 = \left(Z_y + 3 \cdot Z_f\right) \cdot I_0$$

Example with Units

$$60.663\,\text{V} = \left(4.12\,\Omega + 3 \cdot 7.86\,\Omega\right) \cdot 2.19\,\text{A}$$

3) Transformer Sequence Impedance Formulas

3.1) Delta Impedance using Star Impedance Formula

Evaluate Formula

Formula

$$Z_{d(xmer)} = Z_{y(xmer)} \cdot 3$$

Example with Units

$$20.223\,\Omega = 6.741\,\Omega \cdot 3$$

3.2) Leakage Impedance for Transformer given Positive Sequence Voltage Formula

Evaluate Formula

Formula

$$Z_{Leakage(xmer)} = \frac{V_{1(xmer)}}{I_{1(xmer)}}$$

Example with Units

$$6.7466\,\Omega = \frac{13.5\,V}{2.001\,A}$$

3.3) Leakage Impedance for Transformer given Zero Sequence Current Formula

Evaluate Formula

Formula

$$Z_{Leakage(xmer)} = \left(\frac{V_{0(xmer)}}{I_{0(xmer)}}\right) - 3 \cdot Z_{f(xmer)}$$

Example with Units

$$6.7038\,\Omega = \left(\frac{17.6\,V}{2.21\,A}\right) - 3 \cdot 0.42\,\Omega$$

3.4) Negative Sequence Impedance for Transformer Formula

Evaluate Formula

Formula

$$Z_{2(xmer)} = \frac{V_{2(xmer)}}{I_{2(xmer)}}$$

Example with Units

$$-44.5972\,\Omega = \frac{16.055\,V}{-0.36\,A}$$

3.5) Neutral Impedance for Star Connected Load using Zero Sequence Voltage Formula

Evaluate Formula

Formula

$$Z_{f(xmer)} = \frac{\left(\frac{V_{0(xmer)}}{I_{0(xmer)}}\right) - Z_{y(xmer)}}{3}$$

Example with Units

$$0.4076\,\Omega = \frac{\left(\frac{17.6\,V}{2.21\,A}\right) - 6.741\,\Omega}{3}$$

3.6) Positive Sequence Impedance for Transformer Formula

Evaluate Formula

Formula

$$Z_{1(xmer)} = \frac{V_{1(xmer)}}{I_{1(xmer)}}$$

Example with Units

$$6.7466\,\Omega = \frac{13.5\,V}{2.001\,A}$$

3.7) Star Impedance using Delta Impedance Formula

Evaluate Formula

Formula

$$Z_{y(xmer)} = \frac{Z_{d(xmer)}}{3}$$

Example with Units

$$6.74\,\Omega = \frac{20.22\,\Omega}{3}$$

3.8) Zero Sequence Impedance for Transformer Formula

Evaluate Formula

Formula

$$Z_{0(xmer)} = \frac{V_{0(xmer)}}{I_{0(xmer)}}$$

Example with Units

$$7.9638\,\Omega = \frac{17.6\,V}{2.21\,A}$$

Variables used in list of Symmetric Components Formulas above

- I_0 Zero Sequence Current *(Ampere)*
- $I_{0(line)}$ Zero Sequence Current Line *(Ampere)*
- $I_{0(xmer)}$ Zero Sequence Current Xmer *(Ampere)*
- I_1 Positive Sequence Current *(Ampere)*
- $I_{1(line)}$ Positive Sequence Current Line *(Ampere)*
- $I_{1(xmer)}$ Positive Sequence Current Xmer *(Ampere)*
- I_2 Negative Sequence Current *(Ampere)*
- $I_{2(line)}$ Negative Sequence Current Line *(Ampere)*
- $I_{2(xmer)}$ Negative Sequence Current Xmer *(Ampere)*
- $I_{a(line)}$ A-Phase Current Line *(Ampere)*
- I_s Symmetric Component Current *(Ampere)*
- $I_{s(line)}$ Symmetric Component Current Line *(Ampere)*
- V_0 Zero Sequence Voltage *(Volt)*
- $V_{0(line)}$ Zero Sequence Voltage Line *(Volt)*
- $V_{0(xmer)}$ Zero Sequence Voltage Xmer *(Volt)*
- V_1 Positive Sequence Voltage *(Volt)*
- $V_{1(line)}$ Positive Sequence Voltage Line *(Volt)*
- $V_{1(xmer)}$ Positive Sequence Voltage Xmer *(Volt)*
- V_2 Negative Sequence Voltage *(Volt)*
- $V_{2(line)}$ Negative Sequence Voltage Line *(Volt)*
- $V_{2(xmer)}$ Negative Sequence Voltage Xmer *(Volt)*
- V_s Symmetric Component Voltage *(Volt)*
- $V_{s(line)}$ Symmetric Component Voltage Line *(Volt)*
- $Z_{0(xmer)}$ Zero Sequence Impedance Xmer *(Ohm)*
- $Z_{0D(line)}$ Zero Sequence Impedance Delta Line *(Ohm)*

Constants, Functions, Measurements used in list of Symmetric Components Formulas above

- Measurement: **Electric Current** in Ampere (A)
  Electric Current Unit Conversion
- Measurement: **Electric Resistance** in Ohm (Ω)
  Electric Resistance Unit Conversion
- Measurement: **Electric Potential** in Volt (V)
  Electric Potential Unit Conversion

- $Z_{0S(line)}$ Zero Sequence Impedance Star Line *(Ohm)*
- $Z_{1(line)}$ Positive Sequence Impedance Line *(Ohm)*
- $Z_{1(xmer)}$ Positive Sequence Impedance Xmer *(Ohm)*
- $Z_{2(line)}$ Negative Sequence Impedance Line *(Ohm)*
- $Z_{2(xmer)}$ Negative Sequence Impedance Xmer *(Ohm)*
- Z_{d} Delta Impedance *(Ohm)*
- $Z_{d(xmer)}$ Delta Impedance Xmer *(Ohm)*
- Z_{f} Fault Impedance *(Ohm)*
- $Z_{f(line)}$ Fault Impedance Line *(Ohm)*
- $Z_{f(xmer)}$ Fault Impedance Xmer *(Ohm)*
- $Z_{Leakage(xmer)}$ Leakage Impedance Xmer *(Ohm)*
- Z_{s} Sequence Impedance *(Ohm)*
- $Z_{s(line)}$ Sequence Impedance Line *(Ohm)*
- Z_{y} Star Impedance *(Ohm)*
- $Z_{y(xmer)}$ Star Impedance Xmer *(Ohm)*

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7/8/2024 | 7:33:49 AM UTC