Important AC Bridge Circuits Formulas PDF

Formulas

Examples

with Units

List of 26
Important AC Bridge Circuits Formulas

1) Anderson Bridge Formulas

1.1) Capacitor Current in Anderson Bridge Formula

Evaluate Formula

Formula

$$I_{c(ab)} = I_{1(ab)} \cdot \omega \cdot C_{(ab)} \cdot R_{3(ab)}$$

Example with Units

$$2.436\,\text{A} = 0.58\,\text{A} \cdot 200\,\text{rad/s} \cdot 420\,\mu\text{F} \cdot 50\,\Omega$$

1.2) Unknown Inductance in Anderson Bridge Formula

Evaluate Formula

Formula

$$L_{1(ab)} = C_{(ab)} \cdot \left(\frac{R_{3(ab)}}{R_{4(ab)}} \right) \cdot \left(\left(r_{1(ab)} \cdot \left(R_{4(ab)} + R_{3(ab)} \right) \right) + \left(R_{2(ab)} \cdot R_{4(ab)} \right) \right)$$

Example with Units

$$546\,\text{mH} = 420\,\mu\text{F} \cdot \left(\frac{50\,\Omega}{150\,\Omega} \right) \cdot \left(\left(4.5\,\Omega \cdot \left(150\,\Omega + 50\,\Omega \right) \right) + \left(20\,\Omega \cdot 150\,\Omega \right) \right)$$

1.3) Unknown Resistance in Anderson Bridge Formula

Evaluate Formula

Formula

$$R_{1(ab)} = \left(\frac{R_{2(ab)} \cdot R_{3(ab)}}{R_{4(ab)}} \right) - r_{1(ab)}$$

Example with Units

$$2.1667\,\Omega = \left(\frac{20\,\Omega \cdot 50\,\Omega}{150\,\Omega} \right) - 4.5\,\Omega$$

2) De Sauty Bridge Formulas

2.1) Dissipation Factor of Known Capacitor in De Sauty Bridge Formula

Evaluate Formula

Formula

$$D_{2(dsb)} = \omega \cdot C_{2(dsb)} \cdot r_{2(dsb)}$$

Example with Units

$$0.5344 = 200\,\text{rad/s} \cdot 167\,\mu\text{F} \cdot 16\,\Omega$$

2.2) Dissipation Factor of Unknown Capacitor in De Sauty Bridge Formula

Evaluate Formula

Formula

$$D_{1(dsb)} = \omega \cdot C_{1(dsb)} \cdot r_{1(dsb)}$$

Example with Units

$$0.7291 = 200\,\text{rad/s} \cdot 191.87\,\mu\text{F} \cdot 19\,\Omega$$

2.3) Unknown Capacitance in De Sauty Bridge Formula

Evaluate Formula

Formula

$$C_{1(dsb)} = C_{2(dsb)} \cdot \left(\frac{R_{4(dsb)}}{R_{3(dsb)}} \right)$$

Example with Units

$$191.8723\,\mu F = 167\,\mu F \cdot \left(\frac{54\,\Omega}{47\,\Omega} \right)$$

3) Hay Bridge Formulas

3.1) Quality Factor of Hay Bridge using Capacitance Formula

Evaluate Formula

Formula

$$Q_{(hay)} = \frac{1}{C_{4(hay)} \cdot R_{4(hay)} \cdot \omega}$$

Example with Units

$$0.7849 = \frac{1}{260\,\mu F \cdot 24.5\,\Omega \cdot 200\,rad/s}$$

3.2) Unknown Inductance in Hay Bridge Formula

Evaluate Formula

Formula

$$L_{1(hay)} = \frac{R_{2(hay)} \cdot R_{3(hay)} \cdot C_{4(hay)}}{1 + \omega^2 \cdot C_{4(hay)}^2 \cdot R_{4(hay)}^2}$$

Example with Units

$$109.4288\,mH = \frac{32\,\Omega \cdot 34.5\,\Omega \cdot 260\,\mu F}{1 + 200\,rad/s^2 \cdot 260\,\mu F^2 \cdot 24.5\,\Omega^2}$$

3.3) Unknown Resistance of Hay Bridge Formula

Evaluate Formula

Formula

$$R_{1(hay)} = \frac{\omega^2 \cdot R_{2(hay)} \cdot R_{3(hay)} \cdot R_{4(hay)} \cdot C_{4(hay)}^2}{1 + \left(\omega^2 \cdot R_{4(hay)}^2 \cdot C_{4(hay)}^2 \right)}$$

Example with Units

$$27.8825\,\Omega = \frac{200\,rad/s^2 \cdot 32\,\Omega \cdot 34.5\,\Omega \cdot 24.5\,\Omega \cdot 260\,\mu F^2}{1 + \left(200\,rad/s^2 \cdot 24.5\,\Omega^2 \cdot 260\,\mu F^2 \right)}$$

4) Maxwell Bridge Formulas

4.1) Iron Loss in Maxwell Bridge Formula

Evaluate Formula

Formula

$$W_{(max)} = I_{1(max)}^2 \cdot \left(R_{eff(max)} - R_{c(max)} \right)$$

Example with Units

$$16.848\,W = 1.2\,A^2 \cdot \left(13\,\Omega - 1.3\,\Omega \right)$$

4.2) Quality Factor of Maxwell Inductance-Capacitance Bridge Formula

Evaluate Formula

Formula

$$Q_{(max)} = \frac{\omega \cdot L_{1(max)}}{R_{eff(max)}}$$

Example with Units

$$0.5011 = \frac{200\,\text{rad/s} \cdot 32.571\,\text{mH}}{13\,\Omega}$$

4.3) Unknown Inductance in Maxwell Inductance Bridge Formula

Evaluate Formula

Formula

$$L_{1(max)} = \left(\frac{R_{3(max)}}{R_{4(max)}}\right) \cdot L_{2(max)}$$

Example with Units

$$32.5714\,\text{mH} = \left(\frac{12\,\Omega}{14\,\Omega}\right) \cdot 38\,\text{mH}$$

4.4) Unknown Resistance in Maxwell Inductance Bridge Formula

Evaluate Formula

Formula

$$R_{1(max)} = \left(\frac{R_{3(max)}}{R_{4(max)}}\right) \cdot \left(R_{2(max)} + r_{2(max)}\right)$$

Example with Units

$$110.5714\,\Omega = \left(\frac{12\,\Omega}{14\,\Omega}\right) \cdot \left(29\,\Omega + 100\,\Omega\right)$$

5) Schering Bridge Formulas

5.1) Capacitance due to Space between Specimen and Dielectric Formula

Evaluate Formula

Formula

$$C_o = \frac{C \cdot C_s}{C_s - C}$$

Example with Units

$$4.7003\,\mu\text{F} = \frac{2.71\,\mu\text{F} \cdot 6.4\,\mu\text{F}}{6.4\,\mu\text{F} - 2.71\,\mu\text{F}}$$

5.2) Capacitance of Specimen Formula

Evaluate Formula

Formula

$$C_s = \frac{C \cdot C_o}{C_o - C}$$

Example with Units

$$6.4005\,\mu\text{F} = \frac{2.71\,\mu\text{F} \cdot 4.7\,\mu\text{F}}{4.7\,\mu\text{F} - 2.71\,\mu\text{F}}$$

5.3) Capacitance with Specimen as Dielectric Formula

Evaluate Formula

Formula

$$C_s = \frac{\varepsilon_r \cdot [\text{Permitivity-vacuum}] \cdot A}{d}$$

Example with Units

$$6.3842\,\mu\text{F} = \frac{199 \cdot 8.9\text{E-}12\,\text{F/m} \cdot 1.45\,\text{m}^2}{0.4\,\text{mm}}$$

5.4) Dissipation Factor in Schering Bridge Formula

Evaluate Formula

Formula

$$D_{1(sb)} = \omega \cdot C_{4(sb)} \cdot R_{4(sb)}$$

Example with Units

$$0.6104 = 200\,\text{rad/s} \cdot 109\,\mu\text{F} \cdot 28\,\Omega$$

5.5) Effective Area of Electrode in Schering Bridge Formula

Evaluate Formula

Formula

$$A = \frac{C_s \cdot d}{\varepsilon_r \cdot [\text{Permitivity-vacuum}]}$$

Example with Units

$$1.4536\,\text{m}^2 = \frac{6.4\,\mu\text{F} \cdot 0.4\,\text{mm}}{199 \cdot 8.9\text{E-}12\,\text{F/m}}$$

5.6) Effective Capacitance in Schering Bridge Formula

Evaluate Formula

Formula

$$C = \frac{C_s \cdot C_o}{C_s + C_o}$$

Example with Units

$$2.7099\,\mu\text{F} = \frac{6.4\,\mu\text{F} \cdot 4.7\,\mu\text{F}}{6.4\,\mu\text{F} + 4.7\,\mu\text{F}}$$

5.7) Relative Permittivity Formula

Evaluate Formula

Formula

$$\varepsilon_r = \frac{C_s \cdot d}{A \cdot [\text{Permitivity-vacuum}]}$$

Example with Units

$$199.4935 = \frac{6.4\,\mu\text{F} \cdot 0.4\,\text{mm}}{1.45\,\text{m}^2 \cdot 8.9\text{E-}12\,\text{F/m}}$$

5.8) Spacing between Electrodes in Schering Bridge Formula

Evaluate Formula

Formula

$$d = \frac{\varepsilon_r \cdot [\text{Permitivity-vacuum}] \cdot A}{C_s}$$

Example with Units

$$0.399\,\text{mm} = \frac{199 \cdot 8.9\text{E-}12\,\text{F/m} \cdot 1.45\,\text{m}^2}{6.4\,\mu\text{F}}$$

5.9) Unknown Capacitance in Schering Bridge Formula

Evaluate Formula

Formula

$$C_{1(sb)} = \left(\frac{R_{4(sb)}}{R_{3(sb)}}\right) \cdot C_{2(sb)}$$

Example with Units

$$183.3548\,\mu\text{F} = \left(\frac{28\,\Omega}{31\,\Omega}\right) \cdot 203\,\mu\text{F}$$

5.10) Unknown Resistance in Schering Bridge Formula

Evaluate Formula

Formula

$$r_{1(sb)} = \left(\frac{C_{4(sb)}}{C_{2(sb)}}\right) \cdot R_{3(sb)}$$

Example with Units

$$16.6453\,\Omega = \left(\frac{109\,\mu\text{F}}{203\,\mu\text{F}}\right) \cdot 31\,\Omega$$

6) Wien Bridge Formulas

6.1) Angular Frequency in Wien's Bridge Formula

Evaluate Formula

Formula

$$\omega_{(wein)} = \frac{1}{\sqrt{R_{1(wein)} \cdot R_{2(wein)} \cdot C_{1(wein)} \cdot C_{2(wein)}}}$$

Example with Units

$$138.5107\,\mathrm{rad/s} = \frac{1}{\sqrt{27\,\Omega \cdot 26\,\Omega \cdot 270\,\mu\mathrm{F} \cdot 275\,\mu\mathrm{F}}}$$

6.2) Resistance Ratio in Wien Bridge Formula

Evaluate Formula

Formula

$$RR_{(wein)} = \left(\frac{R_{2(wein)}}{R_{1(wein)}}\right) + \left(\frac{C_{1(wein)}}{C_{2(wein)}}\right)$$

Example with Units

$$1.9448 = \left(\frac{26\,\Omega}{27\,\Omega}\right) + \left(\frac{270\,\mu\mathrm{F}}{275\,\mu\mathrm{F}}\right)$$

6.3) Unknown Frequency in Wien Bridge Formula

Evaluate Formula

Formula

$$f_{(wein)} = \frac{1}{2 \cdot \pi \cdot \left(\sqrt{R_{1(wein)} \cdot R_{2(wein)} \cdot C_{1(wein)} \cdot C_{2(wein)}}\right)}$$

Example with Units

$$22.0447\,\mathrm{Hz} = \frac{1}{2 \cdot 3.1416 \cdot \left(\sqrt{27\,\Omega \cdot 26\,\Omega \cdot 270\,\mu\mathrm{F} \cdot 275\,\mu\mathrm{F}}\right)}$$

Variables used in list of AC Bridge Circuits Formulas above

- **A** Electrode Effective Area *(Square Meter)*
- **C** Effective Capacitance *(Microfarad)*
- $C_{(ab)}$ Capacitance in Anderson Bridge *(Microfarad)*
- $C_{1(dsb)}$ Unknown Capacitance in De Sauty Bridge *(Microfarad)*
- $C_{1(sb)}$ Unknown Capacitance in Schering Bridge *(Microfarad)*
- $C_{1(wein)}$ Known Capacitance 1 in Wein Bridge *(Microfarad)*
- $C_{2(dsb)}$ Known Capacitance in De Sauty Bridge *(Microfarad)*
- $C_{2(sb)}$ Known Capacitance 2 in Schering Bridge *(Microfarad)*
- $C_{2(wein)}$ Known Capacitance 2 in Wein Bridge *(Microfarad)*
- $C_{4(hay)}$ Capacitance in Hay Bridge *(Microfarad)*
- $C_{4(sb)}$ Known Capacitance 4 in Schering Bridge *(Microfarad)*
- C_o Capacitance between Specimen and Dielectric *(Microfarad)*
- C_s Specimen Capacitance *(Microfarad)*
- **d** Spacing between Electrodes *(Millimeter)*
- $D_{1(dsb)}$ Dissipation Factor 1 in De Sauty Bridge
- $D_{1(sb)}$ Dissipation Factor in Schering Bridge
- $D_{2(dsb)}$ Dissipation Factor 2 in De Sauty Bridge
- $f_{(wein)}$ Unknown Frequency in Wein Bridge *(Hertz)*
- $I_{1(ab)}$ Inductor Current in Anderson Bridge *(Ampere)*
- $I_{1(max)}$ Current 1 in Maxwell Bridge *(Ampere)*
- $I_{c(ab)}$ Capacitor Current in Anderson Bridge *(Ampere)*
- $L_{1(ab)}$ Unknown Inductance in Anderson Bridge *(Millihenry)*

Constants, Functions, Measurements used in list of AC Bridge Circuits Formulas above

- constant(s): **pi**, 3.14159265358979323846264338327950288
  Archimedes' constant
- constant(s): **[Permitivity-vacuum]**, 8.85E-12
  Permittivity of vacuum
- Functions: **sqrt**, sqrt(Number)
  A square root function is a function that takes a non-negative number as an input and returns the square root of the given input number.
- Measurement: **Length** in Millimeter (mm)
  Length Unit Conversion
- Measurement: **Electric Current** in Ampere (A)
  Electric Current Unit Conversion
- Measurement: **Area** in Square Meter (m²)
  Area Unit Conversion
- Measurement: **Power** in Watt (W)
  Power Unit Conversion
- Measurement: **Frequency** in Hertz (Hz)
  Frequency Unit Conversion
- Measurement: **Capacitance** in Microfarad (μF)
  Capacitance Unit Conversion
- Measurement: **Electric Resistance** in Ohm (Ω)
  Electric Resistance Unit Conversion
- Measurement: **Inductance** in Millihenry (mH)
  Inductance Unit Conversion
- Measurement: **Angular Frequency** in Radian per Second (rad/s)
  Angular Frequency Unit Conversion

- $L_{1(hay)}$ Unknown Inductance in Hay Bridge *(Millihenry)*
- $L_{1(max)}$ Unknown Inductance in Maxwell Bridge *(Millihenry)*
- $L_{2(max)}$ Variable Inductance in Maxwell Bridge *(Millihenry)*
- $Q_{(hay)}$ Quality Factor in Hay Bridge
- $Q_{(max)}$ Quality Factor in Maxwell Bridge
- $r_{1(ab)}$ Series Resistance in Anderson Bridge *(Ohm)*
- $R_{1(ab)}$ Inductor Resistance in Anderson Bridge *(Ohm)*
- $r_{1(dsb)}$ Capacitor 1 Resistance in De Sauty Bridge *(Ohm)*
- $R_{1(hay)}$ Unknown Resistance in Hay Bridge *(Ohm)*
- $R_{1(max)}$ Unknown Resistance in Maxwell Bridge *(Ohm)*
- $r_{1(sb)}$ Series Resistance 1 in Schering Bridge *(Ohm)*
- $R_{1(wein)}$ Known Resistance 1 in Wein Bridge *(Ohm)*
- $R_{2(ab)}$ Known Resistance 2 in Anderson Bridge *(Ohm)*
- $r_{2(dsb)}$ Capacitor 2 Resistance in De Sauty Bridge *(Ohm)*
- $R_{2(hay)}$ Known Resistance 2 in Hay Bridge *(Ohm)*
- $r_{2(max)}$ Decade Resistance in Maxwell Bridge *(Ohm)*
- $R_{2(max)}$ Variable Resistance in Maxwell Bridge *(Ohm)*
- $R_{2(wein)}$ Known Resistance 2 in Wein Bridge *(Ohm)*
- $R_{3(ab)}$ Known Resistance 3 in Anderson Bridge *(Ohm)*
- $R_{3(dsb)}$ Known Resistance 3 in De Sauty Bridge *(Ohm)*

- $R_{3(hay)}$ Known Resistance 3 in Hay Bridge *(Ohm)*
- $R_{3(max)}$ Known Resistance 3 in Maxwell Bridge *(Ohm)*
- $R_{3(sb)}$ Known Resistance 3 in Schering Bridge *(Ohm)*
- $R_{4(ab)}$ Known Resistance 4 in Anderson Bridge *(Ohm)*
- $R_{4(dsb)}$ Known Resistance 4 in De Sauty Bridge *(Ohm)*
- $R_{4(hay)}$ Known Resistance 4 in Hay Bridge *(Ohm)*
- $R_{4(max)}$ Known Resistance 4 in Maxwell Bridge *(Ohm)*
- $R_{4(sb)}$ Known Resistance 4 in Schering Bridge *(Ohm)*
- $R_{c(max)}$ Coil Winding Resistance in Maxwell Bridge *(Ohm)*
- $R_{eff(max)}$ Effective Resistance in Maxwell Bridge *(Ohm)*
- $RR_{(wein)}$ Resistance Ratio in Wein Bridge
- $W_{(max)}$ Iron Loss in Maxwell Bridge *(Watt)*
- ε_r Relative Permittivity
- ω Angular Frequency *(Radian per Second)*
- ω Angular Frequency *(Radian per Second)*
- $\omega_{(wein)}$ Angular Frequency in Wein Bridge *(Radian per Second)*

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