Power Calculation

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Abstract – Understanding how power is consumed in an AC circuit is critical in the application of Alternating Current. AC circuits have the nature of consuming power through their Real resistance and having no power consumed through it’s capacitors and inductors. The analyzed circuits demonstrate this nature and can be instrumental when designing circuits of higher complexity.

I. Measuring the power consumption in AC circuit

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| T1 | 10Khz | | | T2 | 25KHz | | |
| RMS Value | Phase Difference | Pav | RMS Value | Phase Difference | Pav |
| VRL | 2.79V | 0 |  | VRL | 2.83 | 0 |  |
| IR2 | 1.29mA | -47.20˚ | 1.24mW | IR2 | 1.77mA | -23.31˚ | 2.35mW |
| IR3 | 1.45mA | 36.53˚ | 1.58mW | IR3 | .853mA | 62.26˚ | .546mW |

Orientation 1, Branches, at 10KHz and 25KHz

Orientation 2, Bottom Resistor, at 10 KHz and 25KHz

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
|  | 10 KHz | | |  | 25KHz | | |
| RMS Value | Phase Difference | Pav | RMS Value | Phase Difference | Pav |
| VR1 | 1.18V | 0 |  | VR1 | 1.19V | 0 |  |
| IR1 | .787mA | 0 | .465mW | IR1 | .793mA | 0 | .472mW |

These results indicate that there is a change in power consumption with frequency across a resistor when an inductor or a capacitor is put in series with a resistor. This is due to the property that inductors and capacitors have of changing impedance with changes in frequency. In a capacitor, impedance drops as frequency increases. In an inductor, the opposite happens, so impedance increases as frequency increases. This causes a change in current through the components in series as frequency is changed. The change in current through a resistor in series with an inductor or a capacitor then creates a change in power.

The total power delivered is equal to the total power dissipated in all three of the sections together.

|  |  |  |
| --- | --- | --- |
|  | 10KHz | 25KHz |
| Pav | 3.285mW | 3.368mW |

II. Measuring how the power delivered to a load changes

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | R1 = 560Ω | | | R1 = 5.6KΩ | | | R1 = 18KΩ | | |
|  | RMS Value | Phase Diff. | Pav | RMS Value | Phase Diff. | Pav | RMS Value | Phase Diff. | Pav |
| VR1 | 1.97V | 0 | 3.45mW | 5.65V | 0 | 2.80mW | 6.63V | 0 | .379Mw |
| IR1 | 3.52mA | 0 | 1.00mA | 0 | .368mA | 0 |

The maximum power delivered to a resistor with the source impedance equal to that of the branch segment is 1498.57Ω. This is the branch segment’s impedance magnitude.