电子电路手册
Electronic Circuits Manual

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2024.11 – ...

序言

Preface

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Chapter 1 Capacitance

1.1 Large Capacitor

1.1.1 Capacitance Multiplier

This part refers to references [1] and [2]. Below are two basic concepts for capacitance multiplication:

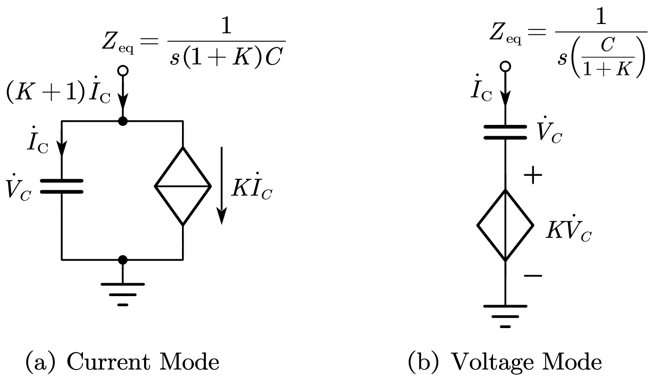

Figure 1.1: Basic Capacitance Multiplier Circuits

Thus, we obtain the equivalent capacitance as:

$$\text{Current Mode:} \ \ C_{\mathrm{eq}} = (1+K)C \Longrightarrow \begin{cases} C_{\mathrm{eq}} > C, & K > 0 \\ C_{\mathrm{eq}} < C, & K < 0 \end{cases} \tag{1.1}$$

$$\text{Voltage Mode:} \ \ C_{\mathrm{eq}} = \frac{C}{1+K} \Longrightarrow \begin{cases} C_{\mathrm{eq}} < C, & K > 0 \\ C_{\mathrm{eq}} > C, & K < 0 \end{cases} \tag{1.2}$$

A simple implementation of cap multiplier, depicted in Fig.1.2, combining a unit-gain buffer (voltage fllower) and a inverting amplifier, is a voltage mode circuit. yielding the equivalent capacitance:

$$C_{\mathrm{eq}} = \frac{C}{1+K} = \frac{1}{1-\frac{R_2}{R_1}} = \frac{R_1}{R_1 - R_2}C \tag{1.3}$$

where $K = -\frac{R_2}{R_1}$ is the closed-loop gain of the inverting amplifier. Since inverting amplifier has a low input impedance, the unit-gain buffer is a necessary. To change it into a two-terminal element, just replace GND with the negtive terminal of the input voltage, e.g. $V_{\mathrm{in},-}$.

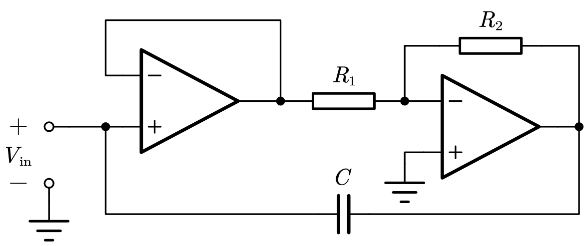

Figure 1.2: A Simple Implementation of Capacitance Multiplier

1.2 Small Capacitor

1.3 Variable Capacitor

Chapter 2 Inductance

Reference

[1] Gabriel Bonteanu. A Review of Capacitance Multiplication Techniques. In *2018 10th International Conference on Electronics, Computers and Artificial Intelligence (ECAI)*, pages 1–4, 2018. https://ieeexplore.ieee.org/document/8678969.

[2] Ivan Padilla-Cantoya, Luis Rizo-Dominguez, and Jesus E. Molinar-Solis. Capacitance multiplier with large multiplication factor, high accuracy, and low power and silicon area for floating applications. *IEICE Electronics Express*, 15(3):20171191–20171191, 2018. https://doi.org/10.1587/elex.15.20171191.

[3] Behzad Razavi. *Fundamentals of Microelectronics*. University of California Press, 2nd edition, 2014.

[4] Behzad Razavi. *Design of Analog CMOS Integrated Circuits*. McGraw-Hill Education, 2nd edition, 2017.