

Time Domain Analysis

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1 Current And Voltage Conventions

The conventions we shall follow, simply state that when current "flows into" the positive terminal of the capacitor/inductor, as indicated by the polarity of v in Fig. 1.1, it is taken as positive. We may then write

$$i = C \frac{dv}{dt}$$
$$v = L \frac{di}{dt}$$

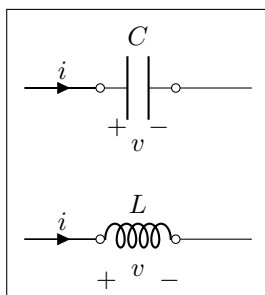


Figure 1.1: The voltage conventions

2 First Order Circuits: RL and RC

A first order circuit is one that is governed by a first order differential equation. Often, it is incorrectly stated that a first order circuit is one that contains only one energy storage element (capacitor/inductor). This is wrong, as there are certain arrangements of $R - L$ and $R - C$ circuits which can be simplified to obtain a first order equation, as we shall see later.

2.1 RL Circuits

2.1.1 The Natural Response

A **natural response** is one that is free of any external voltage/current sources, which are also known as *forcing functions*. It depends on the "general nature" of the circuit (types of elements, sizes and interconnections). It is also known as the **transient response**, as without any external sources, it must eventually die out. Consider the simple series RL circuit shown in