Modeling Poly-Phase Capacitors in an Arbitrary Reference Frame

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***Abstract*—**

I. Introduction

Poly-phase systems are commonly used in power conversion applications in order to take advantage of the improved power handling capabilities for a given voltage and current limit and the ability to make a rotating flux.

II. Complex Vector Formulation

For this paper we use the complex vector formulation described in [**?**] which maps an arbitrary balanced poly-phase system into the complex plane. Equation 1 shows how this is done for three phases.

$$f_{dq} = \frac{2}{3}\left(\alpha_a f_a + \alpha_b f_b + \alpha_c f_c\right) \tag{1}$$

The factor of $2/3$ causes the magnitude of the complex vector to be the same as the magnitude of any of the terminal quantities. This choice requires a factor of $3/2$ in order perform power calculations. Other options for this factor cause other invariants when performing system calculations. The coefficients α_n are the position of the phases in the given reference frame. This can be used with differing α_n on the same phase quantities in order to work in reference frames at different spatial and temporal frequencies. [**?**] From this complex vector formulation, we can multiply by a fixed-speed rotating unit vector to obtain complex quantities in a rotating reference frame.

III. Capacitor Model

In this paper we are working with a three-phase star-connected capacitor with terminal quantities defined in the standard passive convention (voltages referenced phase-to-neutral, currents flowing into the phase terminals). The capacitor voltage differential equations are then

$$\frac{dV_{an}}{dt} = \frac{I_a}{C} \tag{2}$$

$$\frac{dV_{bn}}{dt} = \frac{I_b}{C} \tag{3}$$

$$\frac{dV_{cn}}{dt} = \frac{I_c}{C} \tag{4}$$

IV. Conclusions