

Chapter 3

Some Studies on Switched Mode Power Amplifiers Used in DC Attraction Type Levitation Systems

ABSTRACT

Power amplifier is one of the important elements of any DC attraction type levitation system. Due to the advancement in power electronics and control technology, it is now possible to develop power amplifier which will have the properties of fast dynamics, large bandwidth, ability to carry large payload, energy efficient, high reliability, cost-effective, and suitable for DCALS. Both linear and switching mode power amplifiers have been used in the field of DC attraction type levitation system. In this chapter, different possible switched mode power circuits for both single as well as multi-actuator based levitation system have been discussed, and a comparative study has been made of the different topologies of power amplifiers based on their structure, working principle, simulated, and experimental results.

INTRODUCTION

Power amplifier is one of the important elements of any DC attraction type levitation system. Due to the advancement in power electronics and control technology it is now possible to develop power amplifier which will have

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the properties like fast dynamics, large bandwidth, ability to carry large payload, energy efficient, high reliability, cost-effective and suitable for DCALS (Moon, 1994; Banerjee, et. al. 2008). Both linear and switching mode power amplifiers have been used in the field of DC attraction type levitation system. In this part of work different possible switched mode power circuits for both single as well as multi-actuator based levitation system have been discussed and a comparative study has been made of the different topologies of power amplifiers based on their structure, working principle, simulated and experimental results.

In the actual work design, fabrication and testing of two different DC attraction type levitation schemes have been made as a complete project. But in this chapter the focus is on switched mode power amplifiers suitable for DC attraction type levitation system.

DCALS critically deserves fast response and the DC-DC switch mode power amplifiers used for such applications have important role to meet this demand. The coil current for the magnets used in DCALS needs to be precisely controlled to meet the attractive force demand and this calls for a fast DC to DC power amplifier that can be controlled in a closed loop fashion. The main objective of this part of work is to compare the dynamic performances between these different power amplifiers so that an insight can be made about the selection of power amplifier where speed of response and bandwidth is the prime criterion. The effect of different parameters of chopper amplifier (input DC link voltage, duty cycle and switching frequency) and levitation system (resistance and inductance of magnet coil) on the dynamic responses of power amplifiers also been observed by frequency response analysis utilizing PSPICE (Banerjee, et. al. 2010). Experimental results for comparing dynamic responses of two different switched mode power amplifiers with a single actuator based maglev system have been produced.

DESCRIPTION OF SWITCHED MODE POWER AMPLIFIERS USED IN DC ATTRACTION TYPE LEVITATION SYSTEMS

The main requirement of power amplifier is to quick control of coil-current as well as attraction force developed between electromagnet and ferromagnetic object. To satisfy this objective, both current rise and fall through the magnet-coil must be fast. This current forcing in both positive and negative directions is essential to achieve the necessary bandwidths of suspension system.

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