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Simplified Fault Detection Algorithm for Voltage Source Fed Induction Motor

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Abstract

Industrial applications of induction motor were increased these days due to robust construction. When a three-phase diode clamped inverter is driving this induction motor, the knowledge of inverter performance is very much necessary for the proper operation of induction motor drive. Conventional three-level inverter can drive the induction motor for its speed control. Out of various configurations of MLI, Diode clamped MLI is popular. It has the advantages of simple configuration and requires less number of individual DC sources. But the basic knowledge of faults in the inverter circuit can be very handy for the effective design of induction motor drive system. For the fault mitigation basically the fault detection is to be known. This paper introduces a simple algorithm for the fault identification. This algorithm is very much useful in finding the faulty phase. Out of different faults in the inverter circuit, gate driver faults are common and this paper discusses the gate open fault which is very often fault in the inverter circuit. The simple algorithm also can detect the switch in a leg where this fault occurs. This algorithm is very handy for the fault mitigation. The analysis was carried out using Matlab/Simulink software.

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Keywords: Fault; gate open; algorithm; identification; leg; switch.

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1. Introduction

Induction motor drives are used in almost every industry for mechanical operations. Due to its robust construction induction motor is widely used in industrial applications. The three-phase induction motor, also called an asynchronous motor, is the most commonly used type of motor in industrial applications. In particular, the squirrel-cage design is the most widely used electric motor in industrial applications. Induction motor consists of the fixed mechanical device or frame, a three-phase winding supplied from the three-phase mains and a turning rotor [1-5]. There is no electrical connection between the mechanical device and therefore the rotor. The currents in the rotor are evoked via the air gap from the mechanical device aspect. Stator and rotor are created of extremely magnetizable core sheet providing low eddy current and physical phenomenon losses [6-8].

When inverter is driving an induction motor, the prior knowledge of inverter circuit is very much important for the smooth operation of induction motor drive. In the inverter driven induction motor, the main components present are power electronic switches. Power electronic switches are subjected to faults very often. It is estimated that among every type of faults in variables peed ac drives in trade, about thirty eighth of the faults are due to failures of power devices [9-11]. Most of these inverters use insulated gate bipolar transistors (IGBTs) because the power device attributable to their high voltage and current ratings and talent to handle short-circuit currents for periods exceeding ten μs. But they suffer failures due to excess electrical and thermal stress that are fully fledged in several applications. IGBT failures can be broadly speaking classified as open-circuit faults, short-circuit faults, and intermittent gate-misfiring faults [12-13].

Out of all the faults that might occur in an inverter circuit, gate drive faults are very common fault. Out of gate driver faults, the paper discusses the gate open fault in an inverter circuit. With the prior knowledge of fault analysis, fault clearing is made easy. To mitigate any fault the main task is to first identify the type of fault that occur in an inverter. The simple algorithm was developed for the fault identification in this paper. Only during identification of fault the fault mitigation will be made easy. This paper discusses the gate open fault in three phases of the three-phase diode clamped inverter circuit. The algorithm discussed is capable of identifying the faulty phase and also the switch in particular which was affected by the fault. In this paper, the results were discussed for the fault identification by using the algorithm.

2. Fault Analysis

It is estimated that among every type of faults in variable speed ac drives in trade, about thirty eighth of the faults are due to failures of power devices. Most of these inverters use insulated gate bipolar transistors (IGBTs) because the power device attributable to their high voltage and current ratings and talent to handle short-circuit currents for periods exceeding ten μs. But they suffer failures due to excess electrical and thermal stress that are fully fledged in several applications. IGBT failures can be broadly classified as diode open- faults, diode short-circuit faults, intermittent gate-misfiring faults, switch open and switch short fault.

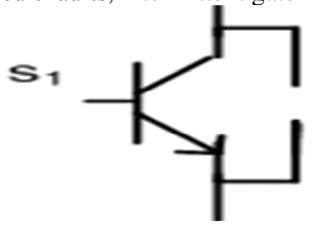

Fig .1: Shows the fault occurred due to the Diode in open condition

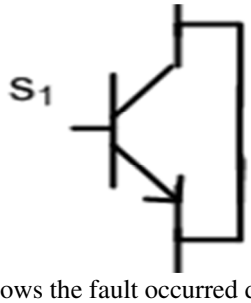

Fig.2: Shows the fault occurred due to the Diode in short condition.