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Engineering

FAULT DETECTION METHOD FOR THREE LEVEL NPC INVERTER BASED ON DC BUS ELECTROMAGNETIC SIGNATURES

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ABSTRACT This paper presents a new fault detection method used for the diagnosis of power electronics converters. Mainly two methods are there the first method uses EMI filter and other one is external near field antenna. As compared to conventional intrusive techniques, these proposed non-intrusive techniques are not sensitive to low frequency disturbance. The near field antenna is used to collect and removes external noises that may affect the inverter. Here a protection system is also proposed for protects the device from short circuit fault.

KEYWORDS : three level inverter; EMI filter; protection circuit

INTRODUCTION

Multilevel converters play a remarkable interest now days. And they are widely used for medium-voltage and high power industrial applications. The three-level neutral point clamped inverter (NPC) is one of the most promising multilevel inverter that has been used in the commercial market several years ago. But the problem is as the number of levels increased the switching devices also increased. Hence the losses due to switching are more in multilevel inverters as compared with the conventional inverters. Here we stimulated a method for detecting accurate and fast identification techniques to identify the faulty power semiconductors with the aim to prevent fault propagation and hence limiting the resulting failure cost. Power semiconductor devices failure can be divided into two, one is short-circuit fault and other is open-circuit faults. Where the short circuit fault will occurs in a system the system will suddenly shut down and safe the circuit. But the open circuit fault will persist in the system itself and it will propagate to the entire devices and damages the secondary parts also. Most of the NPC inverters used conventional intrusive diagnosis techniques to detect the open-circuit faults. They are based on current or/and voltage signature analysis methods. Here used a non-intrusive diagnosis method. Mainly two types of analysis methods are there. One is antenna method and other is EMI filter method. An antenna is placed near to the system, if any fault will occurs in the system this antenna will capture that disturbances and detected. Another method is we have to connect an EMI filter in between the dc line side and the inverter side, hence if any high frequency noise signal will develops this filter will cancel it and safe the dc line side voltage without any fluctuations. Compared to the conventional intrusive diagnosis techniques, the non-intrusive methods are very sensitive to low frequency disturbances. Hence the diagnosis is based on high frequency EMI signatures. Only one extra voltage sensor is needed compared to three extra sensors required by the output voltages signatures based diagnosis techniques. The near-field antenna based diagnosis is completely decoupled from the electrical circuit. So that the fault on the power circuit doesn't have the chance to propagate into the diagnosis circuit.

THREE LEVEL NPC INVERTER

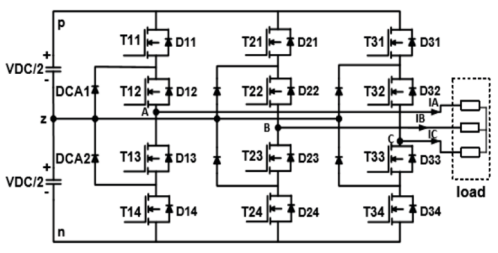


Fig 2.1 NPC inverter

Three level inverter is one of the most promising topology of multilevel inverter. In a three level inverter mainly consist of three legs. Each leg consists of four switches. The upper and lower switches are called main switches. The middle two switches are called auxiliary switches. In a three level inverter mainly have three voltage levels such as positive, zero and negative. The space vector modulation is used here for providing better performance. Whenever fault will occur in the system the current level increases abnormally and damages the other equipments also.

EMI FILTER

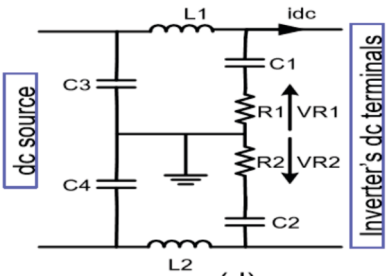


Fig 2.2 EMI filter

Emi filter is nothing but an electromagnetic interference filter that block the high frequency disturbing signals that make interference in the system. Here a pi type filter is used. The pi type filter consists of capacitor and inductors. The capacitors will block the low frequency signals and pass high frequency signals. Whereas the inductor will pass low signal and block high signals. The supply dc will be low frequency signal that will allows the inductor and reaches the inverter terminal. If any fault will occurs high frequency disturbing signals generated and that will be blocks by the inductor. Thus eliminate the interference.

PROPOSED SYSTEM.

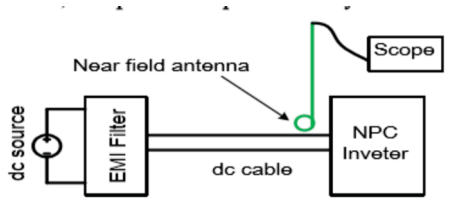


Fig 2.3 proposed model

An electromagnetic interference filter is connected between the DC side and inverter side. Mainly two methods are there first one is filter method and other one is near field antenna method. The near field antenna is used for removing the external disturbance that may affect the system. Filter method used for removing the high frequency disturbing noise signals that affect the system. Main drawback is that the near field antenna method is quiet difficult to handle because as we done the experimental setup the environmental factors are also be considered but it is very complex to done. In filter method the analysis

of common mode emission signature in the dc bus is sensed by voltage across filter. Mainly low cost filter is used. This method is very effective to detect the multiple open circuit fault also.

SIMULATION RESULTS

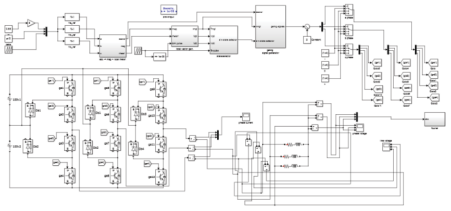


Fig 3.1 simulik model of three level npc inverter

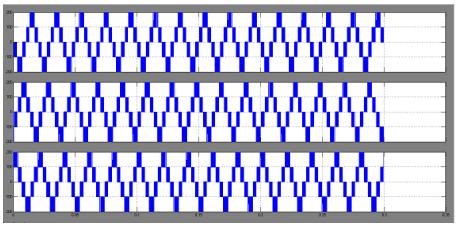


Fig 3.2 line voltage

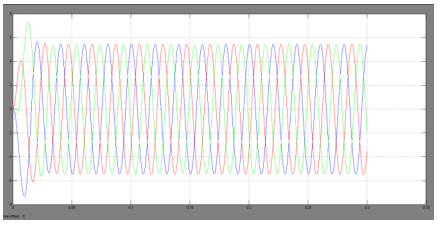


Fig 3.3 phase current

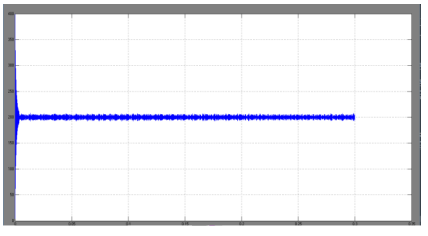


Fig 3.4 dc signal with interference

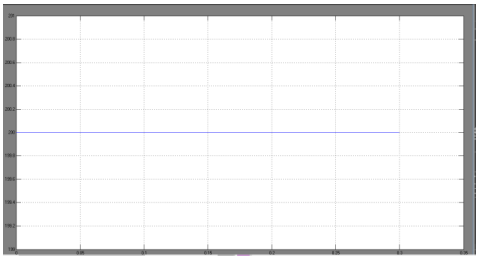


Fig 3.5 dc without interference

CONCLUSION

This paper reflects the idea that due to the high switching frequency that we applied to the inverter may results high frequency interference signals. This interference will reach the input DC side and that propagate to the other devices that connect to the inverter. So using EMI filter it reduces that high frequency interference signal. The protection that we connected to the inverter terminal also protects the device from fault such as open circuit and short circuit.

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