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FAULT IDENTIFICATION OF DC –BUS GRID SYSTEM WITH ACTIVE CLAMPING DUAL FLYBACK CONVERTER PROTECTION

[1]**S. Thomas Praveen Joseph,** Assistant Professor,
EEE Department,Christian College of Engineering and Technology ,oddanchatiram.
thomaspraveen.s@gmail.com,

[2]**Dr P. Paramasivan,** Assistant Professor
EEE Department,Christian College of Engineering and Technology ,oddanchatiram.
1986sivame@gmail.com

Abstract-A fault detection and isolation scheme for dc-bus microgrid systems is presented in this project. The main objective is to isolate the fault segment and protect the whole system. To achieve these goals, a loop-type dc-bus-based microgrid system, which has a segment controller between connected components, is proposed. The system include solid-state bidirectional switches and active clamping snubber circuits. The proposed system can detect faults on the bus regardless of fault current amplitude and Reactive Power injection. The proposed concepts have been verified by MATLAB simulations

Index Terms—DC distribution, fault protection, microgrids,solid-state switch.

I.INTRODUCTION

RECENTLY, many distributed power systems have been researched and developed, especially to meet the demandfor high penetration of renewable energy resources, such as wind turbines and photovoltaic systems. The distributed power systems have advantages, such as the capacity relief of transmission and distribution, better operational and economical generation efficiency, improved reliability, eco-friendliness, and higher power quality [1], [2].In the last two decades,modern solution s such as renewable based DGunits, energystorage systems(ESSs),flexibleACtransmissionsystems(FACTS),activedemandmanagement(ADM), AC microgrids and advanced control strategies based on information and communication technologies(ICTs), have made possible for energy engineers and researchers to redesign the conventional powersystems[3].The microgrid system is a small-scale distributed power system consisting of distributed energy sources and loads, and it can be readily integrated with the renewable energysources [4]–[6]. Due to the distributed nature of the microgrid approach, the connection to the central dispatch can be removed or minimized so that the power quality to sensitive loads can be enhanced. A conceptual diagram of the dc-bus microgrid is shown in Fig. 1.While the advantages of dc microgrids are considerable, the protection of dc distribution systems has posed manychallenges, such as autonomously locating a fault within a microgrid, breaking a dc arc, dc protective equipment, and certainly the lack of standards, guidelines, and experience [7].

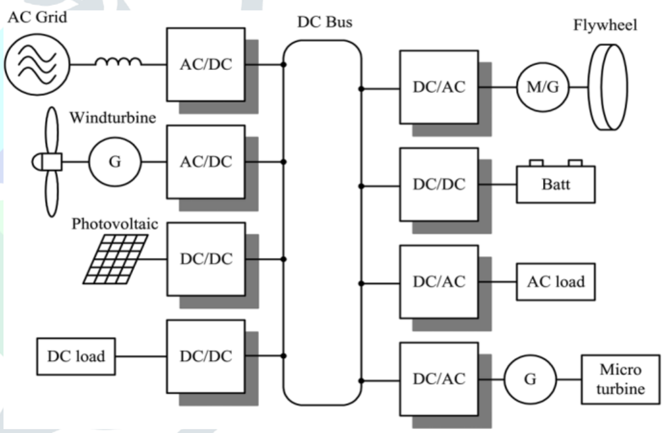


Fig.1.Conceptual diagram of a dc-bus microgrid system.

This paper presents a fault detection and isolation scheme for a dc-bus microgrid system. The goals of the proposed scheme are to detect the fault in a bus segment between devices and then to isolate the faulted section so that the system continues to operate without disabling the entire system. To accomplish these goals, this paper proposes a loop-type dc-bus-based microgrid system which has a segment controller between connected components.

II.DC-BUS MICROGRID SYSTEMS

Microgrid systems In a broader and futuristic manner, microgrids(MGs) are tiny power systems which embed various components such as con- trolled and uncontrolled loads ,DG units and storage devices operating together in a coordinated manner with controlled power electronic devices (active and reactivepowerflow controllers, frequency and voltage regulators) which are integrated with protective devices [8,9]. They can be operated based on the principles of the AC powersystems (i.e.ACmicrogrids) or DC powersystems (i.e.DCmicrogrids). Thus, the architecture of the future energy system will eventually look very different from that. of the conventional energy system along with the MGs expected to be the main building blocks..

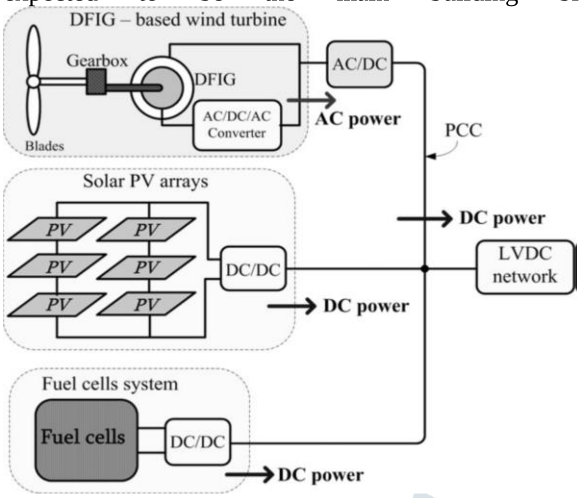


Fig 2.Typical configuration of the DG units with network.

A.ACMICRO GRID SYSTEM

The main system could be an AC or DC bulk system. The DG units and ESS are connected at some points with in the distribution networks. Part of the network consisting of the DG units and load circuits can form a small isolated AC electric powersystem i.e.an 'ACmicrogrid'. During normal operating conditions, the two network share interconnected at the PCC while the loads are supplied from the local sources (e.g. the RES based DGunits) and if necessary from the utility. If the load demand power is less than the power produced by DG units, excess power can be exported to the main system.In most cases, the AC microgrid system operations adopt the voltage and frequency standards applied in most conventional distribution systems

B.DC MICRO GRID SYSTEM

The LVDC distribution network is a new concept which is one possibility to tackle the current power distribution problems and realize the future power system . It has the features that meet the new requirements of the electrical distribution networks. . The LVDC distribution network can improve the efficiency of delivering power to the distribution network. It ensures a higher power quality to the customers than in the present distribution network and facilitates more DGunits' connection .

III. FAULTS IN DC DISTRIBUTION SYSTEMS

A. Possible Faults

Two types of faults exist in dc systems: 1) line to line and 2) line to ground, which can be seen in Fig. 2. A line-to-line fault occurs when a path between the positive and negative line is created, short-circuiting them together. A line-to-ground fault occurs when either the positive or negative pole is short-circuited to ground.

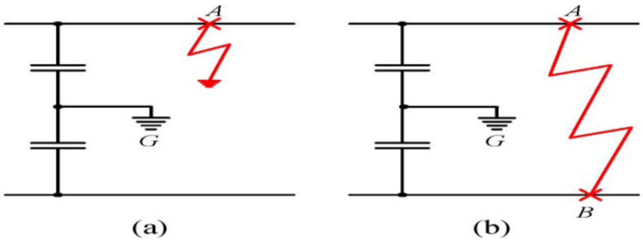


Fig.3.a. line-to-ground fault and (b) line-to-line fault

B. DC Fault Currents

When a fault occurs in a segment, the line current will splitbetween load current and fault current(1) The magnitude of the fault current depends on the fault location and resistance of the fault current path. If the impedance of fault path is low (e.g., a line-to-ground fault with solid ground), the current polarity at the receiving end could be reversed, preventing the load from being supported at all. The fault current from the power source and bus capacitors can be given as follows:(2)where is the line voltage, and are the equivalent resistance and inductance including source, line and ground component, and are the equivalent series resistance (ESR) and capacitance of bus capacitors, respectively. The time constant of the dc fault current is quite small because the line resistance of the dc system is negligible compared to acpowersystems that have high reactance in the line. The bus voltage will drop or even collapse, depending on the capacity of the power supply and energy-storage device in the bus, and the grounding impedance.

C. Current Techniques

The common practice in dc power systems is not to installany protection on the dc side, and upon fault detection the acCBs that link the ac and dc systems are opened [10], [11]. A handshake method was suggested in [11] to isolate and locatethe faulted segment: however, this method completely de energizes the dc system until the fault is removed and the systemscan be re-energized. It works for HVDCand medium-voltage dc (MVDC) transmission systemswhere the dc system is a conduit between the ac systems and loads. However, this methodcan create unnecessary outages in LVDCmicrogridswhere multiple sources and loads are connected to a common bus. Protection techniques such as overcurrent [11], [12], [10], current time derivatives [8], undervoltage and directional protection [9] havebeen reported for LVDC distribution systems and dc shipboard power systems, but the dynamics of voltage and current on a faulted segment, especially when it is separated has not been extensively investigated. Due to the limitations of fuses and traditional ac CBs in dc systems, a solid-state CB has become a valid option for dc power system protection.

IV.PROPOSED PROTECTION SCHEME

A.Proposed Controller

Single-ended active clamp converters are becoming popular for compact DC-DC converters, switching at frequencies beyond 100 kHz.S1 and S2 are main switches carrying load current, while S3 is auxiliary switch. The clamping capacitor (Cc).Connecting with S3 in series.The transformer includes magnetizing inductor Lm and Ls leakage inductor which place an important role in Zvs achieving. DiodeActive clamping method, which explored in detail for dual-switch forward converter was applied in dual switch flyback converter, and a novel ZVZCS active clamped dual switch flyback converter was proposed, which inherits merit of low voltage stress of dual switch Flyback converter. Leakage inductor energy of this topology is utilized to achieve ZVS and rectifier diode realizes ZCS without the help of any other auxiliary circuit, thus switch-on loss is reduced and efficiency is improved

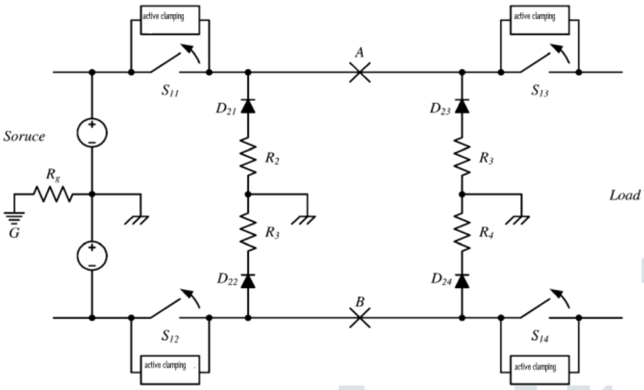


Fig 4.Implementation of the proposed protection scheme.

B. Fault Detection and Isolation

The fault protection for DC bus microgrid system is necessary to reduce the deviation of the fault clearance in this segment the implementation of the active clamping circuit for educe the fault clearance time when the fault occurred the mosfet switch will terminate the voltage by using isolation transformer for both positive and negative clamping. The capacitor clamps the output with filtering the fault duration.then finally fault cleared at 0.25 sec.The active clamping more over eliminates current harmonics at the clearance time.

$$I_{dif}=i_{in}-i_{out} \quad (1)$$

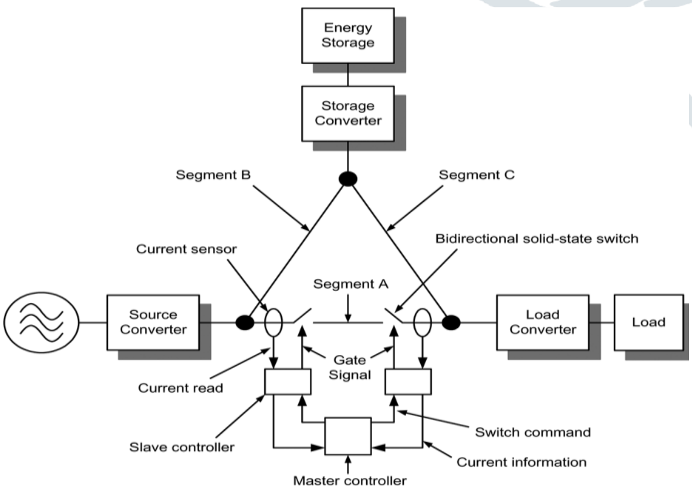
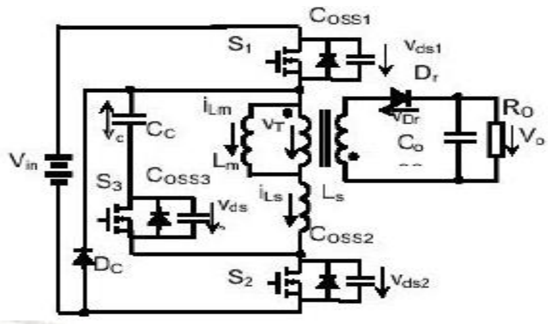


Fig 3.Conceptual diagram of the proposed scheme.

C.Active Clamping Circuit

Power stage of the proposed converter is illustrated in Fig. 1. S1 and S2 are main switches carrying load current, while S3 is auxiliary switch. The clamping capacitor Cc, connecting with S3 in series, serves as a voltage source helping to reset transformer during (1-D) Ts period. Coss1, Coss2 and Coss3 are parasitic output capacitors of S1~S3 correspondingly. The transformer includes magnetizing inductor Lm and leakage inductor Ls which plays an important role in ZVS achieving. Diode Dc is served to clamp the voltage stress on main switches and Dr is the rectifier diode on the secondary side. S1 is supposed to turn off about 50ns earlier than S2 to assure the voltage stress of S1 be exactly input Voltage while S2 bears the same voltage stress as the clamping capacitor Cc.



Figm5.Active clamped duel switch flyback converter.

The driving signals for switches and main principle waveforms are shown in Fig. 2. In order to simplify analysis, it is assumed that the circuit operation is in steady state, the output capacitor CO is large enough to be considered as a voltage source VO.The dead time t1-t3 and t5-t6 is actually rather short; they are lengthened on purpose analysis convenience.

D. Grounding

Grounding is one of the most important factors in the powersystem safety and protection. For a dc distribution system, the advantages of the grounding include predictable operating conditions, minimum voltage stress for the system components, and easier fault detection [11]. The ground fault current can also be limited by using the resistance grounding. Since the typical power-electronics converters connected in the LVDC systems cannot feed large fault currents, it would be beneficial to reduce the fault current to an appropriate level for detection and extinction. However, some protective devices are still needed even with the resistance grounding schemes, because the fault currentcannot be sustained.

V. SIMULATION RESULT

A computer simulation has been performed for a microgridsystem that consists of three typical energy devices: a source,aload, and energy storage. The cable length of 100m is used and corresponding values are listed in the table:

SIMULATION PARAMETERS

Bus voltage	240v
Unit resistance	121milli ohm/m
Unit capacitance	1000micro farad
Unit inductance	10 milliHendry

In the given simulation diagram the protective segment1 and 2 values are taken into account and their corresponding wave forms are shown in the fig

A.SIMULATION DIAGRAM

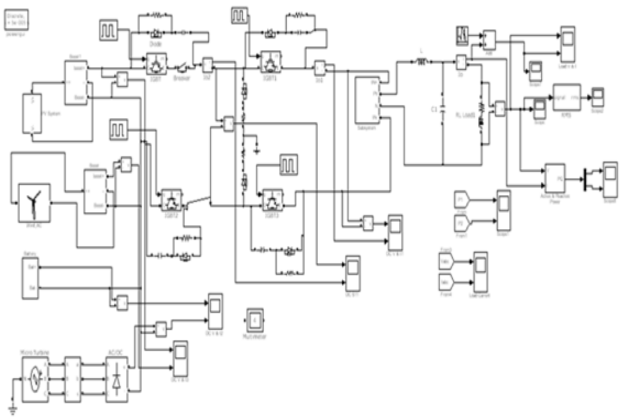


Fig6.simulation diagram of proposed system

B.SIMULATION RESULTS:

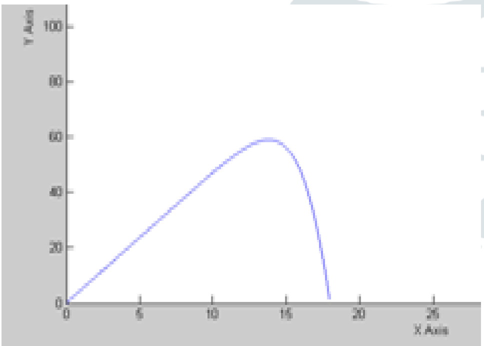


Fig 6.PV curve of solar

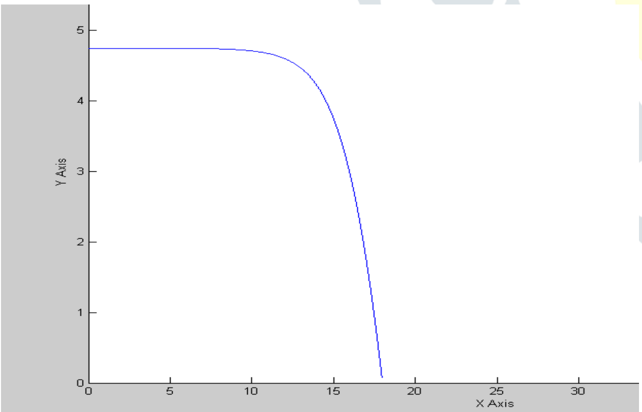


Fig 7.IV curve of solar

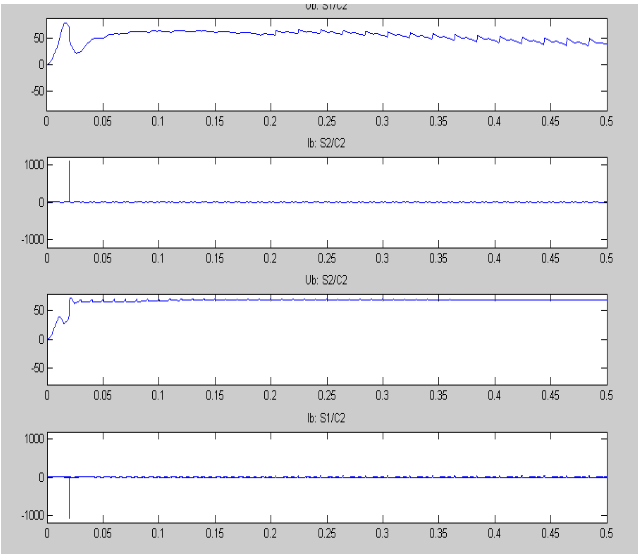


Fig 8. Protection result of the proposed system

VI. **Conclusion:**

A fault detection and isolation scheme for low-voltage dc-bus microgrid systems is proposed in this project. A new ZVZCS topology presented in this project, whose switches all achieve soft-switching, ZVS for main and auxiliary switches, ZCS for rectifier diode. Moreover, duty ratio can be extended to more than 50%. Leakage inductor is fully utilized in the proposed converter, no snubber circuit is needed. All advantage of the converter is quite favorable for improvement of conversion efficiency and power density. And it is very attractive for high input, wide range, and high efficiency practical application of small and medium power. The system include solid-state bidirectional switches and active clamping circuits. The proposed system can detect faults on the bus regardless of fault current amplitude and Reactive Power injection. The proposed concepts have been verified by MATLAB simulations

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