Smart Switching of Multi-terminal Hybrid DC Power Based on Load

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ABSTRACT **:** *A fault protection and location method for a dc bus micro grid system is presented in this paper. If a fault causes the dc bus to de-energize completely, it makes locating faults very difficult. The proposed algorithm can be implemented and executed by an intelligent electrical device for an individual node. The bus was segmented into overlapping nodes and links with circuit breakers (CBs) to isolate the segment in the event of a fault. Backup protection is implemented for circuit breaker failures to improve system reliability. This power can also be used for a pilot test before main CB reclosing to avoid system issues that can be expected when the reclosing fails due to a permanent fault in this paper, we investigate an event-based protection scheme for a multi-terminal dc power system, which includes hybrid energy resources and various loading schemes. The proposed protection scheme transfers less data when compared with commonly used data based protection methods, and do not require high-speed communication and synchronization. Each protection unit is able to autonomously identify the type of event using the current derivative fault identification method, employing artificial inductive line impedance. In order to accurately set the protection relays, detailed fault current analysis considering low pass resistor capacitor filter effects are presented. The decision for fault isolation is made based on the unit judgment and the data received through high-level data communication from other inter-connected units. The performance of the proposed protection scheme was evaluated under different dc feeder and bus faults and its shows that this scheme is able to accurately identify the type of fault, isolate the faulted area, and restore the system quickly while limiting the load voltage drop to its preset limit. The result has been evaluated using the PROTEUS DESIGN SUIT simulation software.*

Keywords: DC ring bus, Hybrid DC power, Smart Relay, fault location, etc.,

1. INTRODUCTION

DC distribution system is a relatively new concept in electric power systems and more advantageous than high voltage DC transmission systems. For a given cable, dc systems can deliver 1.414 times more power than ac systems. DC systems do notn suffer from skin effect, which allows the current to flow through the entire cable and not just the outer edge. Unlike traditional AC distribution systems, protection has been challenging for DC systems. Multi-terminal DC power systems do not have the years of practical experience and standards that AC power systems have. Also, the cur- rent power electronic devices can not survive or sustain high magnitude faults. Conveters will shut down to protect themselves under faulted conditions. This makes locating faults in DC system difficult, and causes the DC bus to de- energize. A fault protection algoritm and method for a low-voltage DC-bus microgrid system is presented in this thesis in order to revolve the above issues. DC micro grid is an effective architecture to achieve a more reliable power with higher efficiency through the implementation of the power electronic converters and the storage energy devices. In various applications, such as telecommunication systems, shipboard and spacecraft, and distribution systems involving a large number of electronic loads and data centres, dc architectures provide a more effective solution for electric power distribution. However, there is a widespread concern over the means used to protect the system against short circuit faults, especially in multisource distribution systems and multi-terminal dc lines. The protection of a power system that includes a large number of buses and feeders can be categorized into the data-based and event-based protection schemes. In the data-based protection method, electric variables such as the converter current or the bus voltage are measured and sent to the interconnected protection unit to execute fault identification algorithms. In the event-based protection scheme, the measured fault parameters are locally analyzed to classify the type of event. Then, the event judgment is sent to other interconnected protection units through high-level data communication.

2. PROPOSED SYSTEM

An event-based protection scheme for a multi-terminal dc power system, which includes hybrid energy resources and various loading schemes. Each protection unit is able to autonomously identify the type of event using the current derivative fault identification method, employing artificial inductive line impedance. In order to accurately set the protection relays, detailed fault current analysis considering low pass resistor capacitor filter effects are presented. The decision for fault isolation is made based on the unit judgment and the data received through high-level data communication from other interconnected units. The main aim of this project is fault protection and location method for DC bus micro grid system along with MPPT techniques. The main goal of the proposed system is to detect and isolate the fault in DC BUS without de-energize entire system and identify the fault location. In fault occurring time we can manipulate the power in the circuit. To the load depends upon the power in coming to the load. Power management to the load depends upon the power.

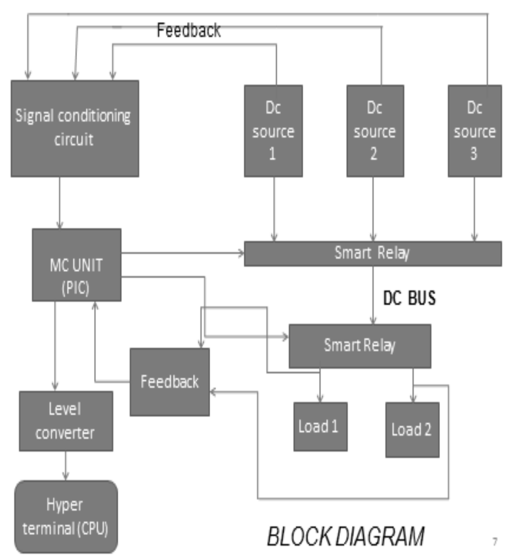


Fig 2.1.Block Diagram Of Multi-terminal hybrid DC power system with Smart relay

Many dc sources are connected individually to a single battery. When battery gets fully charged continuous charging makes wastage of dc sources, to avoid the wastage of dc sources in continuous charging the battery, even battery gets fully charged. We proposed a novel method to reduce the usage of dc sources using the ring bus dc network .Once the battery gets fully charged the dc sources energy is used to run any dc load. Whenever battery charge is less, the dc sources shifted to charging the battery.

3. SIMULATION SOFTWARE

3.1. SIMULATION DIAGRAM

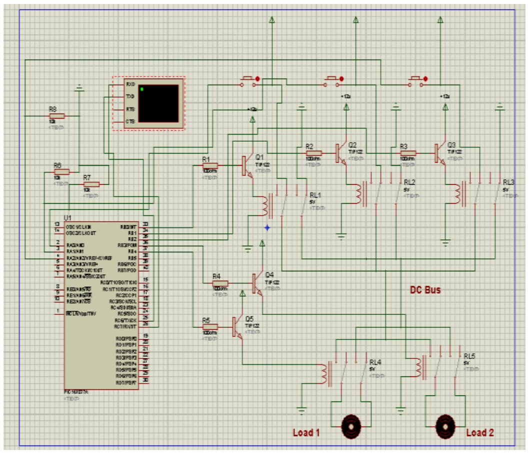
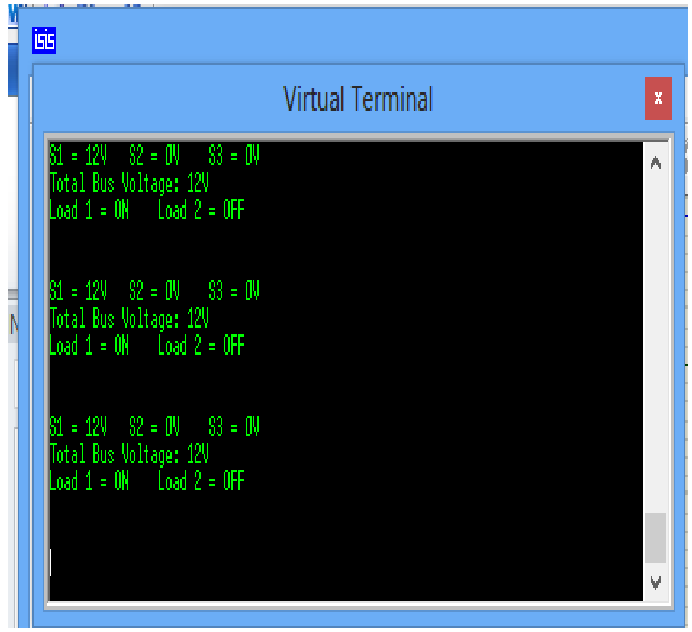


Fig 3.1. Simulation Diagram

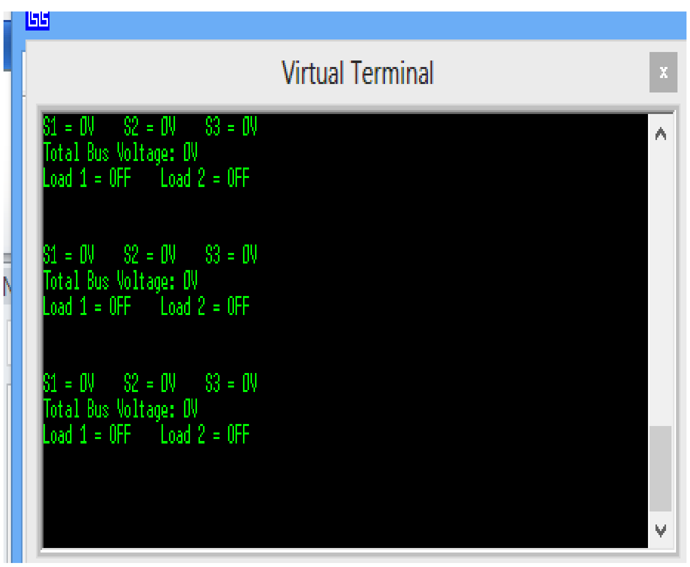
DC BUS RING SIMULATION PROGRAM

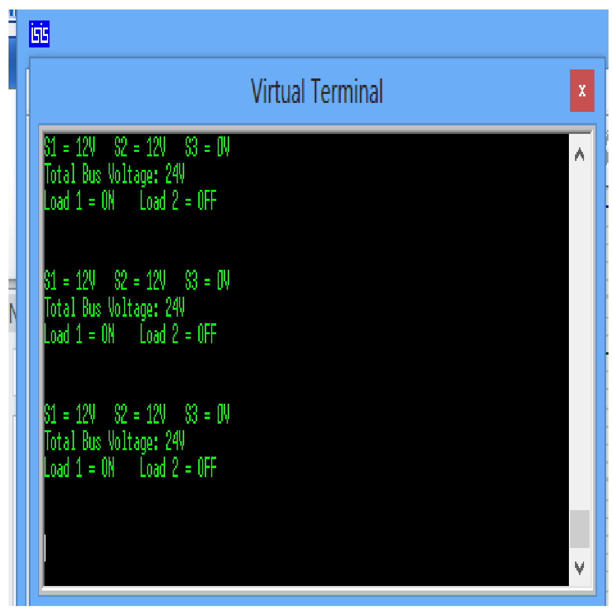
```
#include <16f877a.h>
#use delay(clock=4000000)
#use rs232(baud=9600,xmit=pin_c6,rcv=pin_c7)
void main()
{
unsigned int a=0,b=0,c=0;
unsigned int x=0,y=0,z=0;
unsigned int i=0,j=0,k=0;
unsigned int v=0;
set_tris_b(0);
output_b(0);
setup_adc(ADC_CLOCK_INTERNAL); // clock frer
setup_adc_ports(2); // indicates what are the analog ports
printf("*****welcome****\n\r");
printf("*****DC BUS RING****\n\n\n");
delay_ms(1000);
while(1)
{
set_adc_channel(0);
delay_ms(10);
a=read_adc();
x=a/21.25;
if(x>1)
{
x=8+x;
i=1;
printf("S1 = %u ",x);
output_low(pin_b2);
v=v+x;
}
else
{
i=0;
printf("S1 = LOW");
output_high(pin_b2);
}
set_adc_channel(1);
delay_ms(10);
b=read_adc();
y=b/21.25;
if(y>1)
{
y=8+y;
j=1;
printf("S2 = %u ",y);
output_low(pin_b3);
v=v+y;
}
else
{
j=0;
printf("S2 = LOW");
output_high(pin_b3);
}
set_adc_channel(2);
delay_ms(10);
c=read_adc();
z=c/21.25;
if(z>3)
{
z=8+z;
k=1;
printf("S3 = %u \n\r",z);
output_low(pin_b4);
v=v+z;
}
else
{
k=0;
printf("S3 = LOW\n\r");
```

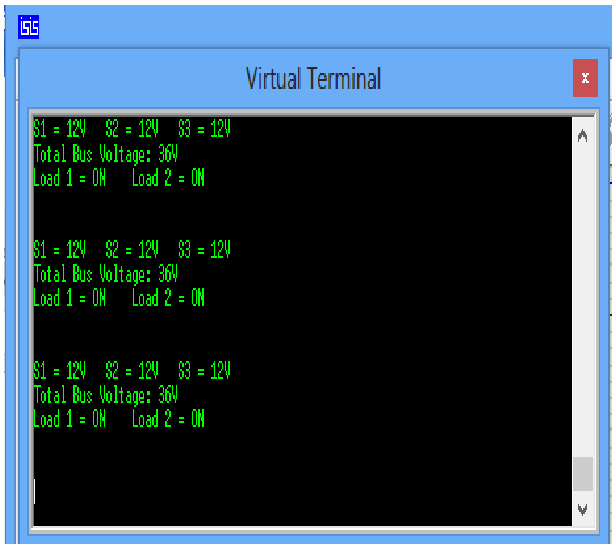
```
output_high(pin_b4);
}
printf("DC BUS Total Voltage = %u \n\r",v);
v=0;
if((i==1) && (j==1) && (k==1))
{
output_high(pin_b0);
output_high(pin_b1);
printf("Load 1 = ON    Load 2 = ON\n\r\n\r\n\r");
}
else if((i==0) && (j==0) && (k==0))
{
output_low(pin_b0);
output_low(pin_b1);
printf("Load 1 = OFF    Load 2 = OFF\n\r\n\r\n\r");
}
else
{
output_low(pin_b0);
output_high(pin_b1);
printf("Load 1 = ON    Load 2 = OFF\n\r\n\r\n\r");
}
```



3 OUTPUT OF SIMULATION







CONCLUSION

To overcome the DC bus failure we introduced the ring bus method. We additionally added a smart controller unit which maintains the power management and load management in DC ring bus through smart relay unit. An event-based protection scheme for a multi-terminal hybrid dc micro-grid was investigated. The notional micro-grid considered for this paper was implemented in hardware and its dynamic operation was experimentally tested. Also, for dynamic operation and fault study, an accurate model of this micro-grid was implemented in the Proteus design suit environment and evaluated using the experimental test results and the analytical calculations. In the proposed protection strategy developed here, each power unit was able to identify the type of event autonomously. Since high-level data communication was utilized, the protection system did not require high-speed communication and synchronization. The performance of the grid and the proposed protection scheme were evaluated using analytical fault current calculation and a simulation model. The results confirm that the proposed protection scheme is fast and accurate and the grid can ride-through the fault uninterrupted. The detailed analytical analysis given in this paper provided essential guidelines to set the protection relays for an event-based protection scheme. This can be utilized in multi-terminal dc micro-grid, such as renewable energy distributed generation micro-grids, data centres, or shipboard power systems where self-diagnosing and self-reconfiguring capability is in high demand.

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