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Power Quality Improvement Using Direct Converter For An AC Load

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I. ABSTRACT

Voltage sag disturbances are the most frequently occurring Power Quality problems in the distribution system. This paper explains simulation of a dynamic voltage restorer as a voltage sag and swell mitigation device in electrical power distribution networks. A Dynamic Voltage Restorer is proposed to handle deep voltage sags, swells and outages on a low voltage single phase residential distribution system. The dynamic voltage restorer with its excellent dynamic capabilities, when installed between the supply and a critical load can compensate for voltage sags/swells, restoring line voltage to its nominal value within a few milliseconds and hence avoiding any power disruption to the sensitive load. Otherwise, it will operate as an Uninterruptable Power Supply across the sensitive load when disturbance occurs on the supply voltage. It is also designed to reduce the usage of utility power. A series injection transformer is connected in series with the sensitive loads which restoring voltage sag and swell to a nominal voltage by protecting the sensitive load from damage.

II. INTRODUCTION

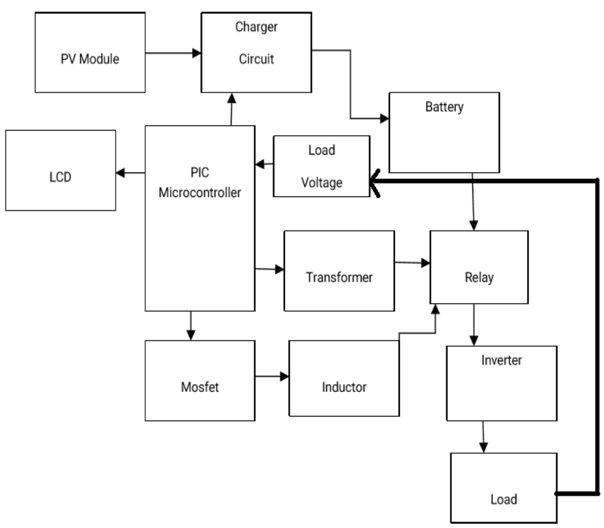
In the early days of power transmission voltage deviation occurs during load changes, power transfer limitation was observed due to reactive power unbalances. Modern power systems are complex networks, where hundreds of generating stations and thousands of load centres are interconnected through long power transmission and distribution networks. The main concern of customer is the quality and reliability of power supply at various load centres.

Even though power generation in most welldeveloped countries is fairly reliable, the quality of supply is not. there are two major challenges that the modern power grid must deal with voltage fluctuations and short circuit faults. With wide use of nonlinear loads, the grid suffers from voltage fluctuation, voltage unbalance, and other power quality problems Power distribution system should ideally provide their customers an uninterrupted flow of energy with smooth sinusoidal voltage at the contracted magnitude and frequency. However, in practice power system especially the distribution system, have numerous nonlinear loads, which are significantly affect the quality of power supply. As a result, the purity of waveform of supply lost. This ends up producing many power quality problems such as voltage sag, voltage swell.. Voltage sag is a sudden reduction of utility supply voltage from90% to 10% of its nominal value. On the other hand, voltage swell is a sudden rise of supply voltage from 110% to 180% of its nominal value. A typical duration of voltage sag and swell is 10 ms to 1 minute. The voltage sags and swells often caused by starting of large induction motors, energizing a large capacitor bank and faults such as single line to ground fault, three phase to ground fault, double line to ground fault on the power distribution system At the same time, many power loads become more sensitive to these disturbances. To improve power quality, custom power devices are used. Dynamic Voltage Restoration is a method and apparatus used to sustain, or restore, an operational electric load during sags, or spikes, in voltage supply.They employ a series of voltage boost technology using solid state switches for compensating sags/swell

III. OBJECTIVE

Fast mitigation of power quality problems
Power quality improvement
Voltage compensation against voltage disturbances such
As voltage sag voltage swell
Short Circuit Protection

IV. BLOCK DIAGRAM

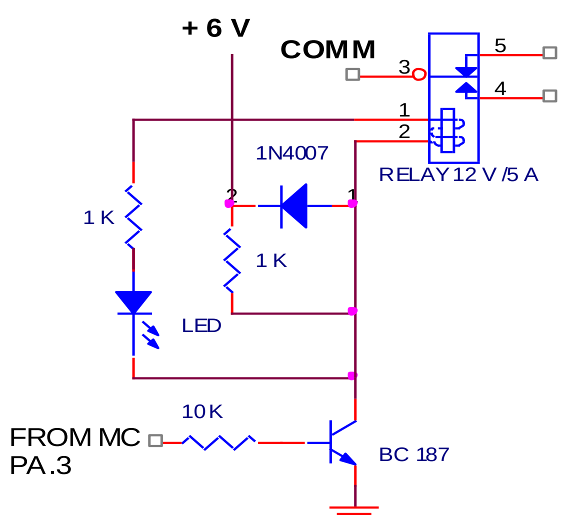


V. PROPOSED SYSTEM

Dynamic Voltage Restorer are now being established in industrial areas to mitigate voltage disturbances on sensitive loads. In our dynamic voltage restorer concept propose the new technique to compensate voltage by using Magnitude traction or Magnitude estimation method. Ac supply is given to the step down tap changing transformer. The output voltage from the step down tap changing transformer is compared with the reference voltage which is programed in the PIC. To correct the error between a measured process variable and a desired set point, the PIC controller is used and controller is also used for magnitude traction of supply voltage. To decrease the error signal, it is compared with a reference signal to produce sine PWM pulses. This sine PWM pulse is generated only when the difference in voltage waveform occurs. The driver circuit consists of opto coupler, transistor and driver IC act as a driver for MOSFET to provide required pulses from the Microcontroller. Solid-state semiconductor devices with turn off capability are used in inverter circuits. A VSI is energized by a stiff DC voltage supply of low impedance at the input. The output voltage is independent of load current. The nonlinear characteristics of semiconductor devices cause distorted waveforms associated with harmonics at the inverter output. To overcome this problem and provide high quality energy supply, filter unit is used. The output voltage from filter is given to the series injection transformer. The series injection transformer is used to inject missing

voltage to the load. If the input AC voltage is need not to step down means we can directly use rectifier and it converts AC to DC. The DC supply is given as input to inverter and the remaining processes are same.

VI. RELAY

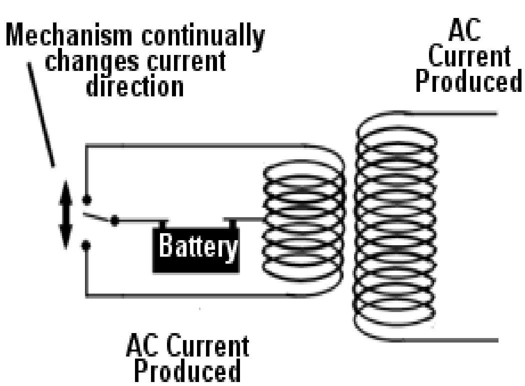


Relays are electrically controlled switches. In the usual type, a coil pulls in an armature when sufficient coil current flows. Many varieties are available including “latching” and “stepping” relays; the later provided the cornerstone for telephone switching stations, and theyre still popular in pinball machines. Relays are available for dc or ac excitation, and coil voltages from 5 volts up to 110 volts are common. "Mercury-wetted" are "reed" relays are intended for high-speed (~ 1ms) applications, and giant relays intended to switch thousands of amps are used by power companies.

Transistor or FET switches, and devices known as solid-state relays are now available to handle ac switching applications.

Remote switching and high-voltage (or high-current) switching. Because it is important to keep electronic circuits electrically isolated from the ac power line, relays are useful to switch ac power while keeping the control signals electrically isolated. The electrical relay offers a simple on / off switching action in response to a control signal. When a current flows through the coil of wire a magnetic field is produced. This pulls a movable arm, the armature, that forces the contacts to open are close; usually there are two sets of contacts with one being opened and the other closed by the action.

VII. INVERTER



A direct current from a battery to the primary coil it would not induce a current in the secondary as the magnetic field would not be changing. However, if we can make that direct current effectively change direction repeatedly, then we have a very basic inverter. This inverter would produce a square wave output as the current would be changing direction suddenly.

A more sophisticated inverter would use transistors to switch the current. The switching transistors are likely to be switching a small current which is then amplified by further transistor circuitry. This will still be a square wave inverter.

To get a sinusoidal alternating current from the output of our transformer, we have to apply a sinusoidal current to the input. For this we need an oscillator.

VIII. BATTERY CELL

Galvanic Action

In simple terms, batteries can be considered as electron pumps. The internal chemical reaction within the battery between the electrolyte and the negative metal electrode produces a build up of free electrons, each with a negative charge, at the battery's negative (-) terminal - the anode.

The chemical reaction between the electrolyte and the positive (+) electrode inside the battery produces an excess of positive (+) ions (atoms that are missing electrons, thus with a net positive charge) at the positive (+) terminal - the cathode of the battery.

The electrical (pump) pressure or potential difference between the + and - terminals is called voltage or electromotive force (EMF).

Different metals have different affinities for electrons. When two dissimilar metals (or metal compounds) are put in contact or connected through a conducting medium there is a tendency for electrons to pass from the metal with the smaller affinity for electrons, which becomes positively charged, to the metal with the greater affinity which becomes negatively charged. A potential difference between the metals will therefore build up until it just balances the tendency of the electron transfer between the metals. At this point the "equilibrium potential" is that which balances the difference between the propensity of the two metals to gain or lose electrons.

A battery or galvanic cell stores energy in chemical form in its active materials and can this convert this to electrical energy on demand, typically by means of an electrochemical oxidation-reduction, redox reaction (see below).

Each galvanic or energy cell consists of at least three and sometimes four components

The anode or negative electrode is the reducing or fuel electrode. It gives up electrons to the external circuit and is oxidised during the elecrochemical (discharge) reaction. It is generally a metal or an alloy but hydrogen is also used. **The anodic process is the oxidation** of the metal reducing agent to form metal ions.

*(**LEO** Lose Electrons - **Oxidation**)*

Alternatively

*(**OIL** - Oxidation is Loss)*

The cathode or positive electrode is the oxidising electrode. It accepts electrons from the external circuit and is reduced during the electrochemical (discharge) reaction. It is usually an metallic oxide or a sulfide but oxygen is also used. **The cathodic process is the reduction** of the oxidising agent (oxide) to leave the metal. (**GER** Gain Electrons **Reduction**). Remember the mnemonic of the lion growling.

Alternatively

(**RIG** - Reduction is Gain) Alternative mnemonic - **OIL RIG**

The electrolyte (the ionic conductor) which provides the medium for transfer of charge as ions inside the cell between the anode and cathode. The electrolyte is typically a solvent containing dissolved chemicals providing ionic conductivity. It should be a non-conductor of electrons to avoid self discharge of the cell.

Metal ions are metal atoms missing electrons and are thus positively charged. Particles missing electrons are called cations and during discharge they move through the electrolyte towards the cathode.

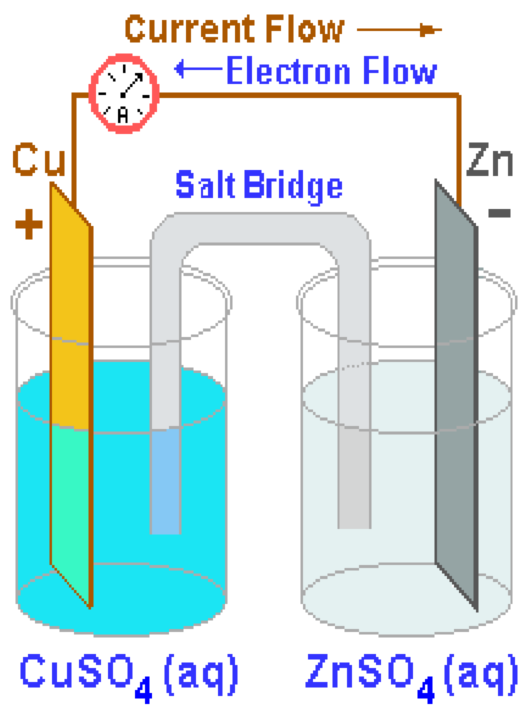
Anions are atoms or particles with excess electrons and thus negatively charged. During discharge they are attracted towards the anode.

Discharge Process

When the battery is fully charged there is a surplus of electrons on the anode giving it a negative charge and a deficit on the cathode giving it a positive charge resulting in a potential difference across the cell.

When the circuit is completed the surplus electrons flow in the external circuit from the negatively charged anode which loses all its charge to the positively charged cathode which accepts it, neutralising its positive charge. This action reduces the potential difference across the cell to zero. The circuit is completed or balanced by the flow of positive ions in the electrolyte from the anode to the cathode.

Since the electrons are negatively charged the electrical current they represent flows in the opposite direction, from the cathode (positive terminal) to the anode (negative terminal).



IX. CONCLUSION

A design and development of Dynamic Voltage Restorer for voltage Sag and Swell compensation for improving power quality is developed. When compared with the existing method Where Fast Mitigation of voltage sag is achieved by mathematical modeling, the proposed method is capable to compensate the power quality problems like voltage sag and voltage swell within a milliseconds. This proposed method can be used in the distribution sides to protect the sensitive loads getting damage and increase its life time.

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