

# Power Quality Enhancement using Custom Power Devices

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**Abstract**— A Power quality problem is an occurrence manifested as a nonstandard voltage, current or frequency that results in a failure or mis-operation of end use Equipments. Utility distribution networks, sensitive industrial loads, and critical commercial operations all suffer from various types of outages and service interruptions which can cost significant financial loss per incident based on process down-time, lost production, idle work forces, and other factors. With the restructuring of Power Systems and with shifting trend towards distributed and dispersed Generation, the issue of Power Quality is going to take newer dimensions. The aim therefore, in this work, is to identify the prominent concerns in the area and thereby to recommend measures that can enhance the quality of the power, keeping in mind their economic viability and technical repercussions. In this paper three custom power controllers: DVR, DSTATCOM (modelled in MATLAB/Simulink), PWM Switched Autotransformer (modelled in PSCAD/EMTDC & MATLAB/SIMULINK) are presented. Comprehensive results are presented to assess the performance of each device to mitigate the Voltage sag and economical device is proposed.

**Index terms**— Power Quality Problems, Voltage sag, DVR, DSTATCOM, PWM Switched Autotransformer

## I. INTRODUCTION

Power quality is certainly a major concern in the present era; it becomes especially important with the introduction of sophisticated devices, whose performance is very sensitive to the quality of power supply. Modern industrial processes are based a large amount of electronic devices such as programmable logic controllers and adjustable speed drives. The electronic devices are very sensitive to disturbances [1] and thus industrial loads become less tolerant to power quality problems such as voltage dips, voltage swells, and harmonics. Voltage dips are considered one of the most severe disturbances to the industrial equipment. Swells and over

voltages can cause over heating tripping or even destruction of industrial equipment such as motor drives. Electronic equipments are very sensitive loads against harmonics because their control depends on either the peak value or the zero crossing of the supplied voltage, which are all influenced by the harmonic distortion.

This paper analyzes the key issues in the Power Quality problems. As one of the prominent power quality problems, the origin, consequences and mitigation techniques of voltage sag problem has been discussed in detail. The study describes the techniques of mitigating voltage sag in a distribution system by two power electronics based devices called Dynamic Voltage Restorer (DVR) and Distribution STATCOM (D-STATCOM) and a new mitigation technique called PWM Switched Autotransformer.

## II. SOURCES AND EFFECTS OF POWER QUALITY PROBLEMS

The distortion in the quality of supply power can be introduced enhanced at various stages; however, some of the primary sources of distortion [2] can be identified as below:

- A. Power Electronic Devices
- B. IT and Office Equipments
- C. Arcing Devices
- D. Load Switching
- E. Large Motor Starting
- F. Embedded Generation
- G. Electromagnetic Radiations and Cables
- H. Storm and Environment Related Causes etc.

Some of the common power quality issues and their prominent impact are summarized in the table below:

TABLE I

Problem	Effects
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