

## Co-existence between AC-distribution and DC-distribution: in the view of appliances

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**Abstract**—This work demonstrates the possibility of using the available-in-market appliances in a DC-distribution system. This demonstration also represents an alternative migration from AC-distribution to DC-distribution. DC-distribution has been shown to be more efficient and provided good power quality in a distribution system. The power supply technology in the modern appliances makes the possibility of an appliance to be used in either both AC-distribution and DC-distribution without any modification. Appliances are tested by using an AC-source as the base-line and then the test replaces the AC-source by a DC-source.

**Keywords**-component; DC power distribution; house-hold appliances; migration path for DC distribution; future house

### I. INTRODUCTION

The benefit of the DC distribution over the AC distribution has been presented by many researchers [1-4]. DC-distribution has been shown to be more efficient and provided good power quality in a distribution system. DC-distribution allows the flexibility of merging many energy sources.

Most of the DC researches concentrate on the appliances that have been modified to suite the DC distribution. The modification is not only made the appliance to operate on the DC distribution but the modification also allows the improvement on efficiency by removing the unnecessary AC/DC converter [5].

This work considers the behavior of the commercially available-in-the-market appliances in the DC environment. The appliances will not be modified. According to [6], the DC voltage level at 140 V to 220 V would allow most world-wide voltage appliances to normally operate without any modification.

The concept of this work is to demonstrate an alternate migration path from AC distribution to the DC distribution. The migration can be done by having both distributions coexist. The coexistence of both distributions can be at any level, for example, in a house-hold community where parts of the community having DC distribution or in an industry where some power transmissions have been done in DC for efficiency improvement.

The study aims to consider the steady-state characteristics of the intake voltage and current on the DC-distribution comparing to the characteristics on the AC-distribution. Only the steady-state characteristic is

considered in this work due to the fact that the transient characteristic will be affected by some protections e.g. [7]. This comparison is to shown the success in using appliances on both AC and DC distribution and the effect on the power quality.

The characteristics of tested appliances are given in the next session. Then the testing environment and procedure are followed. The details of tested appliances and the result are shown.

### II. APPLIANCE CHARACTERISTICS

An appliance, that is capable to operate on both AC and DC source, usually contains a certain kind of AC/DC converters. Most modern appliances that accept the world-wide voltage range is capable of using both AC and DC source, because the AC/DC converter is by-passed in the DC case.

The sample appliances are chosen based on their input voltage characteristics and the availability in our laboratory or our sponsors.

The tested appliances represent the appliances that are use often in daily life. The appliances are lighting systems (compact fluorescent lamp and LED), office equipment (notebook computer), entertainment system (TV) and motor drive. Each represents some characteristics that can be inherited to other appliances.

- **Lighting systems** guarantees the possibility to deploy the DC distribution in the real world, because the lighting is the common load in all places.
- The **notebook computer** is a good representation of the appliances that using an external adapter.
- The **TV set** represents the appliances with the built-in switching mode power supply.
- The **motor drive** demonstrates the ability to use the electromechanical devices in the DC environment. Most modern appliances, e.g. refrigerator, air condition, equipped with electromechanical devices are controlled by an inverter for efficiency. The motor drive is also presented the case when the appliances cannot be use in DC environment. The motor drive represents the same concept as DC/AC converter.

Although some appliances are not listed to accept the world wide voltage range, they might be able to operate in the DC environment. A certain issues are needed to be considered.