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**An Analysis of the Influences of Power Electronics Devices on  
Fundamental Frequency Front Ends**

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## **Abstract**

New power electronics devices like Fundamental Frequency Front Ends (F3E) reduce procurement costs by eliminating or reducing the intermediate capacitors usually found on the DC-side of modern rectifier-inverter combinations. This cost-saving measure, however, eliminates the quasi-decoupling of rectifier and inverter; whereas interactions between rectifier and inverter could be neglected in most applications. These interactions are relevant to the correct function and operation of the whole application in case of reduced intermediate capacitors. Without the decoupling of rectifier and inverter, the inverter input currents will be passed on to the rectifier, and ultimately, will be discernible on the power grid. As a result, the input currents of the appliance will deviate greatly from the idealised sinusoidal waveform. To reduce this effect, an input filter is used, which in turn might interact with other power electronics devices connected to the same power grid.

To date, the scope of the rectifier inverter and the F3E third-party equipment interactions has not been sufficiently investigated. An examination with real devices is impractical due to the wide range of configurations possible and the potential harm to the equipment itself. In this study, the simulation models of the devices involved and the power grid connecting different appliances were developed. A theoretical analysis to identify possible areas of impaired or disturbed operation was undertaken. The areas identified were then analysed using the computer models developed. The simulation results, electrical currents, and voltages were examined with regards to their absolute values and their degree of deviation from the idealised sinusoidal form. Their harmonic spectra were likewise analysed. Finally, areas of disturbed operation and the conditions under which they occur were identified. This study, therefore, will provide the basis for the successive elimination of these areas of disturbed operation.

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