Mara University of Technology

SINGLE PHASE PULSE WIDTH MODULATION RECTIFIER

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Abstract

After the development of semiconductors, conversion from AC source to DC source is possible. Earlier, conventional diode rectifier does not offer the control ability of its operation. Later, advanced development of semiconductors has made the rectifier with control ability. Phase controlled thyristor rectifier became very popular but it was found that they also created negative side effects which injected current harmonics to the supply network which affected power quality. Nowadays, modern industrial demanded control features of power converters while new regulations impose more stringent limits to current harmonics injected by the power converters. The introduction of single phase PWM rectifier is present in this thesis, its operation, switching technique and control technique was studied. The design of all variable parameters in the converter is also present. The results of simulation by using Matlab Simulink software and the calculation design are compared.

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Chapter 1
Introduction

Many electronic devices are usually using either diode or thyristor rectifiers for its power conversion from AC to DC, normally diode were used for uncontrolled rectifier while thyristors were used for controlled rectifier. On the other side they load supply network with higher harmonics and with reactive power i.e. created grid disturbances. Nowadays those problems become more serious and must be taken into account. Grid disturbances may result in malfunction or damage of other electrical devices that are sensitive to the supply voltage of sinusoidal shape which connected on the same network. Many methods for reduction or elimination of harmonics pollution in the power system are investigated and developed by the power utilities company; one way is the application of the passive LC filter. Passive LC filter is usually constructed with inductors and capacitors connected to the grid. The values of the elements are chosen to have resonance frequency, which corresponds with the frequency of the harmonics, which should be eliminated. That means each series of harmonics requires its own filter. That is why filters can not be designed in general way, but must be design according to each application. Such a solution is simple but requires additional cost and reduces reliability of the whole system.

Phase angle control features and the commutation of power semiconductor devices in phase controlled thyristor rectifier gives impact on the phase displacement between the first harmonics of consumed current and supply voltage. This displacement leads to power factor degradation and to reactive power consumption. The consumed current harmonics cause the deformation of supply voltage (became non-sinusoidal) and non-sinusoidal voltage drops on the supply network impedances. The reactive power rises with longer control angle delays, so the rectifier is acting as time variable impedance which is furthermore nonlinear and causes the deformed current consumption. This situation will become worse if the electrical supply network connected with inductive loads.

The other possible reduction or elimination technique for harmonics pollution in the power system is the application of a PWM rectifier. PWM rectifier constructed with power semiconductor devices that can be switched off called Insulated Gate Bipolar Transistor (IGBT). PWM rectifier is controlled by pulse width modulation. Rectifier