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学位論文の概要及び要旨

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題　　目　A STUDY ON ELECTRONIC BALLAST FOR ILLUMINATION EQUIPMENT
（照明用電子バラストに関する研究）

学位論文の概要及び要旨

This is a summary of the author's PhD thesis supervised by Professor Yoshio Itoh at Tottori University. The thesis is written in English. This work deals with electronic ballast for illumination equipment and the problems faced by illumination equipment, mainly harmonics distortion emitted by the electronic ballast itself or from other sources. In chapter 1, Total Harmonic Distortion (THD) and issues related to it are presented. The International Electrotechnical Commission (IEC) has set standards to limit THD emitting 61000-3-2 and the electronic ballast for illumination equipment falls to category C of this strict regulation. Previously developed electronic ballast is the two-stage electronic ballast and the one-stage electronic ballast, each has their advantages and weaknesses. In this thesis, the advantages of the one-stage converter compared to the two-stage converter are justified. The objective of this work includes producing high efficiency rectifier circuit, while minimizing the usage of circuit element by adapting the one-stage converter method, eliminate inrush current during initial start-up and also circuit applications. In chapter 2 of this thesis, THD filtering technique for electronic ballast is written. Three known methods are the passive filtering, partial smoothing and active filtering. Each filtering method has its advantages and weaknesses such as cost issues and

not satisfying the strict IEC harmonics limitation standard. Only active filtering satisfies the IEC harmonics limitation standard but in an expenses to cost. Traditionally active filtering adapts the two-stage electronic ballast method but also one-stage electronic ballast has also been proposed by other researchers. The active filtering under one-stage converter method is regarded as the best balance between cost and quality. In this thesis, we propose the Neutral Point Type converter for application to electronic ballast. This thesis presents 4 converter circuits, two under the Neutral Point type boost converter, that is the Improvised boost converter and the PFC1 inverter. The Neutral Point type buck-boost converter is presented in chapter 4 and application of both Neutral Point type boost converter and Neutral Point type buck-boost converter to Voltage free converter is presented in chapter 5. The Neutral Point Type boost converter satisfies the IEC harmonic regulations but problem due to no current flow during low voltage intake is solved by the Improvised boost converter circuit. In the improvised boost converter circuit, charge-pumping allows current to flow during low voltage intake. The Power Factor Correction (PFC) inverter further miniaturized the electronic ballast by sharing circuit elements within the filter and circuits itself. The major drawback of the Neutral Point type boost converter is inrush current. This was solved by the Neutral Point type buck-boost converter introduced in chapter 5. The circuit disables a closed loop of voltage input mains with the electrolytic capacitor thus reducing inrush current during initial start-up. In chapter 6, the development of the Neutral Point type converter for application to a voltage free converter circuit is presented. The circuit can tolerate both 100V and 200V input voltages. Mechanical switch is used to switch ON and OFF for 100V and 200V input voltages. In chapter 6, the conclusion and unsolved problems are finally presented and future research is suggested.