
**AIN SHAMS UNIVERSITY**

**FACULTY OF ENGINEERING**

**Electronics and Communications Engineering Department**

# Design and Layout Automation for LDO Regulators

**A Thesis**

Submitted in partial fulfillment of the requirements of the degree of

Master of Science in Electrical Engineering

Submitted by

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B.Sc. of Electrical Engineering

(Electronics and Communications Engineering)

Ain Shams University, 2007

Supervised By

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Cairo, 2014

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Thesis: Design and Layout Automation for LDO Regulator

Degree: Master of Science in Electrical Engineering

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# STATEMENT

This thesis is submitted to Ain Shams University for the degree of Master of Science in Electrical Engineering (Electronics and Communications Engineering).

The work included in this thesis was carried out by the author at the Electronics and Communications Engineering Department, Faculty of Engineering, Ain Shams University, Cairo, Egypt.

No part of this thesis was submitted for a degree or a qualification at any other university or institution.

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# ABSTRACT

*Mohamed Essam Sayed Hussein, Design and Layout Automation for LDO Regulators, Master of Science thesis, Ain Shams University, 2014.*

Analog design has always been a more involved process than digital design. it takes to longer to master so it comes the importance of Analog Design Automation (ADA) to short the time to market and to reach to the optimum design at the same time. However the researches in this field are still not efficient enough to replace the manual design.

This thesis aims to introduce a design automation tool for low drop-out voltage regulators in both circuit and layout regulation by dividing the circuit to its building blocks and introduces a macro model in order to speed up the optimization process. Finally it compares between the time effort and the accuracy between the manual design and the automation approach.

**Key words:** CMOS, analog design**,** software, LDO, automation, pass transistor, SKILL, ocean, operational amplifier, simulation analysis, figure of merit, layout, inter-digitation, common centroid.

# SUMMARY

This thesis demonstrates the importance of the Analog Design Automation (ADA) in CMOS technology. ADA will be very important in the near future to reduce the time of design cycle. The thesis is in five chapters organized as follows:

**Chapter One** begins with a motivation for the thesis and introduction to the design automation. Next, it describes the work done and the contribution in the thesis. Finally, it describes the thesis chapters and organization.

**Chapter Two** begins with an introduction for the analog design automation approaches. Next, it introduces a survey for the macro models techniques. Finally, it ends by a survey for the previous work on LDO design automation and the achievement in this area.

**Chapter Three** starts with an over view for LDO (Low Drop Out) voltage regulators and power management circuits. Next, it introduces the description and the analysis for LDO circuit design. Finally, it ends by a survey on the previous work in LDO design automation.

**Chapter Four** begins with an over view for LDO required specifications. Next, it introduces the LDO basic block circuit design. Finally, it ends by the achieved circuit results and the corner simulation results.

**Chapter Five** begins with a description for the proposed design automation flow. Next, LDO building blocks and macro model design are described. Finally, it ends by LDO circuit integration, simulation and a comparison with the manual design results and design effort.

**Chapter Six** begins with addressing the placement problem in EDA and the layout consideration. Next, it gives an overview of the most recent placement tools developed. Finally, it ends by a detailed description for the LDO analog layout Implementation.

Finally, the thesis ends by extracting conclusions and stating future work that might be done based on this work.

Additionally, Appendix A, B and C are added for more information regarding SKILL programming language and LDO automation flow.

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