

## **Abstract**

For Master's Certification on the topic:

«Investigation of the ways to decrease the influence of structure and process variation on characteristics of IC»

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### **The Relevance**

Modern integrated circuit technologies tend to smaller device sizes. This leads to increase of impact on characteristics of integrated circuits of process variations. Due to the influence of many unavoidable factors present manufacturing technologies are still unable to produce devices without mismatch problems. These component mismatches destroy the performance of high accuracy integrated circuits. A good understanding of matching behavior of components available in a particular integrated circuit technology is critical in designing analog IC's.

### **The Purpose**

The purpose of this diploma is to analyze modern models for simulation of mismatch due to structural and process variation in integrated circuits, layout techniques for improved matching and introduce new models for simulation of systematic mismatch for further analysis of layout techniques.

### **Problems that are solved**

To achieve this goal in this paper the following problems were solved:

- The detailed analysis of existing methods of modeling random and systematic mismatch;
- The detailed analysis of layout techniques;
- Comparison of layout techniques and models;
- Development of new model for systematic mismatch analysis, that includes more parameters, than existing models; o Development of new model for systematic mismatch analysis, that considers the effect of shape of devices on matching properties.

## **Results Achieved:**

Upon reaching the result in solving problems in goal, the author defends:

- the importance of detailed analysis of mismatch introduced by both systematic and random components;
- the critical role of special layout techniques for improved matching;
- developed by the author model for systematic mismatch analysis, that includes more parameters; o developed by the author model for systematic mismatch analysis, that considers the effect of shape of devices on matching properties.

## **Scientific novelty**

Scientific novelty of the work is the development of new models for more detailed analysis of matching in integrated circuits with inclusion of new elements and coefficients.

## **The practical value**

The practical value of the work is in more precise analysis of layout techniques for designers to have opportunity to choose appropriate layout technique in each precise integrated circuit and to predict its behavior.

## **Conclusions**

As a result of main investigation:

1. The advantages and drawbacks of different models for systematic and random mismatch calculation, device shapes and device arrangements for matching improvement are defined and ranged.
2. The main recommendations from fulfilled analysis are the next:
  - Devices with circular symmetry have the best matching properties under conditions of gradient.
  - For simulation of precision analog circuits the models, which include gradient of carrier mobility and gate oxide capacitance are the most precise.

3. Two new models for systematic mismatch modeling have been proposed and estimated. These models take into account more device parameters than existing and consider the shape of used devices.

The work contains: 119 pages, 64 pictures, 2 tables, 52 sources.

**Key Words:** MATCHING, MISMATCH, CURRENT MIRROR, LAYOUT TECHNIQUE.