WORST CASE ANALYSIS METHODS USED FOR DESIGN VERIFICATION IN THE AUTOMOTIVE ELECTRONICS INDUSTRY

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Abstract: The paper presents the principles of Worst Case Analysis (WCA), a new cost effective method for screening a design. The main field of application is the analysis of the electronic circuits used in automotive industry. The paper is the result of almost two years of experience applying WCA methods on the electronic modules. It presents the analysis of a digital input interface circuit, where a diode leakage current influences the threshold voltage at the microcontroller input.

Key words: Worst Case Analysis, design reliability, electronic circuits testing, automotive industry.

1. INTRODUCTION

The paper presents the basics of WCA including the WCA definition, methods and tools used to perform this analysis on the electronic circuits for the automotive industry. To reflect these methods and tools an example of applying WCA on a digital input interface circuit is presented.

The presentation is based on almost two years experience of the authors in performing WCA. Last year two of the authors joined the University of Michigan, College of Engineering and Computer Science Dearborn as research scholars, for six months.

WCA was used and developed for the first time in the military and aerospace industry, being extended to the automotive industry. WCA can be applied not only at the circuit level but also at the system level, like computers network (including software reliability), control systems and so on.

The main purpose of the paper is to make known the advantages of using WCA to increase the design reliability.

2.1. WCA Basics

Industry Definition: WCA is "*A rigorous mathematical evaluation of a circuit's performance attributes against performance tolerance limits, under simultaneous existence of all the most unfavorable conditions being at realizable limits*". [2]

2.2. WCA – Extreme Value Analysis Example

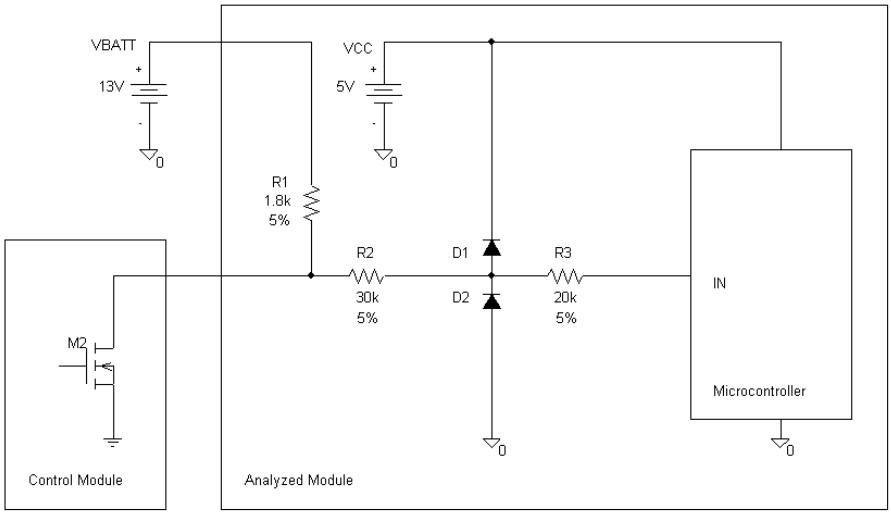

Figure 1. Digital input interface circuit.

When the input signal from the Control Module is low, the micro input pin voltage should be under 0.3 x VCC. Worst case parameters:

- maximum battery voltage VBATT_max = 16V
- minimum VCC_min = 4.9V
- maximum Rdson_M2 =0.575ohms.
- minimum R1, maximum R2, maximum R3
- 1V ground offset voltage between the two modules
- 7uA board leakage current injected into pin from power supply line
- 5uA worst case maximum leakage current of D1 @ Ta = 125^0C
- +/-10% tolerance (temperature and aging) for resistors with 5% tolerance.

Determination of maximum worst-case micro input voltage is done using Pspice A/D Simulator. Worst case value: **V_IN_max = 1.552V (> VCC_min x 0.3 = 1.47V).**

The solution is to reduce the voltage drop across the R2, decreasing its value at 20k. We obtain the following result: **V_IN = 1.421V** (within specs.)

Conclusion: WCA designs high reliability into circuits and is cost effective in both the short and long run by reducing number of hardware design iterations during development phase, reducing time in test, increasing production efficiency, creating trouble free field operation, assuring long life products and customer satisfaction.

3. REFERENCES

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