A MONOLITHIC OFF-CHIP IDDQ MONITOR

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Abstract

An integrated off-chip I_{DDQ} measuring unit (IOCIMU) is described in this paper. The semi-digital current monitor is designed for the use with standard automatic test equipment (ATE). Simulations of the monolithic monitor implemented in a 2-µm BiCMOS technology show an accuracy better than 1% for currents in the range from 0 to 1mA and a test rate up to 10kHz.

Introduction

The effectiveness of the I_{DDQ} tests depends mostly on the test rate and accuracy of the current measurement. Off-chip monitors offer more versatility and they are preferably used in combination with ATE. The development of I_{DDQ} monitors has attracted serious attention from industry as well as academia since ITC93'. The proposed integrated monitor (IOCIMU) can be placed on the load board close to the DUT and the decoupling capacitance C_{DEC}, which loads the monitor and slows down the measurement, can be then minimized.

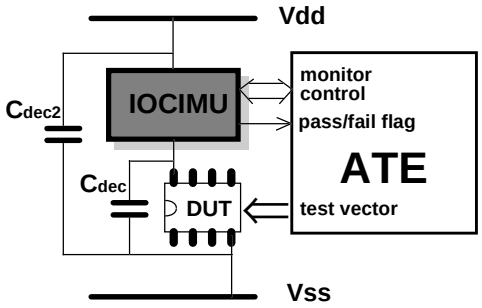

Fig. 1: Off-chip I_{DDQ} monitoring

Implementation of the monitor

The architecture of the designed monitor has evolved from the dicrete OCIMU current monitor [1]. It consists of current measuring (CMU), overcurrent (OCU), and current bypass (CBU) units (Fig 2). The CMU works as a floating current-to-voltage (I/V) converter with the virtual ground connected to Vdut. The measurement rate is proportional to the time constant $\tau \approx R_i \times C_{DEC}$. The differential voltage drop across Rs, which is proportional to the load current, is converted to a single-ended voltage V_{IDDQ} and amplified by the novel sense amplifier SA. The pass/fail flag *p/f* is then generated by the comparator CMP, comparing V_{IDDQ} with the reference level Vpf corresponding to the pass/fail current level. The main purpose of the CBU is to bypass the monitor during changes in the DUT current when a new test vector is applied. The OCU is activated when the output of OA is approaching saturation and it temporarily supplies the overcurrent to the faulty DUT [2].

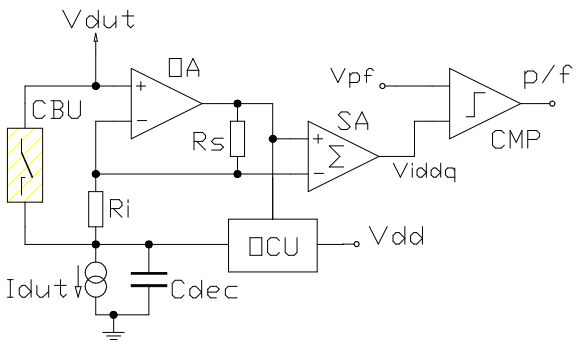

Fig. 3: Simplified monitor structure

Simulations of monolithic implementation of the I_{DDQ} monitor show an accuracy better than 1µA for currents in the 1-200µA range and a test rate up to 10kHz. The monitor is capable to drive a decoupling capacitance Cdec up to 1µF.

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References

[1] H. Manhaeve, P.L. Wrighton, J. van Sas, and U. Swerts, „An Off-Chip I_{DDQ} Current Measurement Unit for Telecommunication ASICs“, ITC 94', paper 7.2

[2] H. Manhaeve, M. Svajda, and B. Straka: „Semi-Digital Off-Chip I_{DDQ} Monitor Developments: Towards a General-Purpose Digital Current Monitor“, Int. Workshop on I_{DDQ} Testing, Washington, USA, 1996, pp. 89-93

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