Detection of IC usage using AF based sensor

Venugopala Krishnan J1, Anisha SR2
1Head of the Department, (M.Tech, Ph.d) Jeppiaar Engineering College, Chennai, India
2M.E, VLSI Design, Jeppiaar Engineering College, Chennai, India
*Corresponding author: E-Mail: jvenu123@gmail.com

ABSTRACT

The reusage of various electronic components has become the major impact in today’s world. One among the major counterfeiting is IC usage. Various On-Chip methods like RO based sensor are used to detect the usage of IC. But these methods will detect only for a particular period. In this paper, we proposed a new On-Chip IC detection method known as Anti-fuse based sensor. This AF based sensor will count the values when the power supply is ON. The power up timing is used to detect the usage of IC. Even for a very short period it will analysis the usage time.

KEY WORDS: counter, one time programmable memory, power-up timing, look-up table, AF based sensor.

1. INTRODUCTION

The integrated circuits (ICs) counterfeiting method is probably impacting the security of various electronic systems. A recycled or a duplicate component is not genuine. Because of its identical functionality and packaging distinguishing usage of IC is a tedious task. From one of the survey it is reported that the usage of counterfeiting ICs is more than the new IC. If this method of IC usage gets increased day by day, then quality of the electronic component will also get reduced. In addition, it is also suggest that the number is going to increase over time. Demand for the counterfeiting electronics products will be more comparable to the new one because of its reduced cost. This will degrade the performance of the IC. In today’s world integrated ICs play a major role for the manufacture of each and every electronic equipment. Counterfeiting ICs must be used to protect the electronic equipment. So to detect the usage of IC, one of the best method is On-Chip IC detection.

2. METHODS & MATERIALS

Existing method

Physical unclonable function: Each and every ICs security operation is secret, which cannot duplicated. Various properties of PUF are capacity, tamper-evidence etc. These properties make them very appealing for deployment in cryptographic application. Any special manufacturing process and testing steps are not required (Lu, 2011). It will not detect the whether the IC is reused one or new one but instead it will authenticate the integrated ICs. (Lu, 2011).

Fingerprint: Even in designs with large process and temperature variations, fingerprint method is very effective. This method has no area overhead, Less power consumption, Resilient to attacks and Better simulation results. But the temperature variations could make it difficult to detect recovered ICs.

Silicon odometer: Separates the aging effects of HCI, BTI, TDDB. This method has High frequency resolution. But it consumes high power.

The above three existing methods will authenticate the integrated ICs but it will not detect whether the IC is recycled one or new one.

Proposed Method: The recycled ICs are used ICs and it will experience aging. This is the major difference between recycled ICs and unused ICs. The fresh ICs are removed from their actual boards and resold in the market. Negative-bias temperature instability and hot-carrier injection are various aging effects that occurs due to counterfeiting of ICs. These would have had an impact on the performance of the counterfeiting ICs because of the change in threshold voltage. In this paper, we proposed AF-based sensor with power up timing for the detection of recycled ICs.

Af-based sensor:

![AF Based Sensor System](image_url)

The traits of AF block in the AF-based sensor are as follows:

- It consumes less power
- The area of an AF is much smaller
It does not require subsidiary mask.

Most AF memories are programmed in a programming environment with comparatively high voltage/current.

**Modified CAF sensor:** The structure of the modified CAF based sensor is composed of power up timing, counters, a data read module, an adder, and an AFOTP memory block. Number of counts of the frequency signal is measured by the counter. When the power supply is ON, data will be stored in registers (counters). But when the power supply is OFF, the stored data gets lost and it won’t get restored. To overcome this disadvantage, non-erasable memory should be used in this sensor. Non-erasable memory is a One-time programmable memory. Once the value is stored it won’t get lost, instead the value will be stored in the look-up table as 1, 2, ..., and so on. Hence this embedded AF-OTP block is used to store the usage time information. Normally Field programmable memory is used for the IC usage detection. But in this paper to get the accurate and appropriate usage time we are using this one time programmable memory.

![Figure 2. Modified CAF based sensor](image)

Fig. 2 is the structural representation of modified CAF based sensor. Power up timing is used in this sensor. This power up timing is given to the counter. Counter will count the clock cycle. This counter is then given to the adder. The stored values are in reg1, reg2 and reg. Lookup table is at the bottom of CAF. The stored values from the register is given to the control module. At each time, when IC is in ON mode the power up timing is updated in the look up table. The value 1 will be written in the counter for the first time. If power is ON for the second time then the counter value will be stored as 2. This process continues until the power up timing updated its value in lookup table. This power up timing of the IC is permanently stored in the memory. The usage of memory is less so the power consumption also gets reduced.

The advantages of AF block in the AF-based sensor are as follows:

- consumes less power
- smaller in area.
- additional mask or manufacturing handing steps during fabrication is not required.

3. RESULT AND DISCUSSION

![Figure 3. Antifuse based sensor](image)

Figure 3 shows the simulated output of antifuse based sensor. Clock pulse is generated. Using this clock pulse simulation usage of IC is detected. In this the clock pulse can be represented in the form of both digital and the binary form.
Figure 4 shows the power and delay calculation of antifuse based sensor. The calculated power is 0.05 and the delay is 10.65 ns. Thus by using this method power consumption is reduced. Here the software used is Xilinx to calculate the power. This gives the accurate value for power and delay.

4. CONCLUSION

Thus the proposed design using antifuse based sensors detects the usage of ICs. The counters and an embedded antifuse (AF) memory block, record the usage time of ICs and this stored values will be dynamically stored in the AF memory block by controlling the programming signal. By using this design counterfeiting of IC usage can be easily detected and also the power and delay can be reduced. This method provides high power consumption and provides high reliability.

REFERENCES


