Testing the Robustness of Physical Unclonable Functions Implemented on Commercial Off-the-Shelf NAND Flash Memories Using Programming Disturbances to Temperature and Voltage Variations

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In this work, we present a Physical Unclonable Function (PUF) implemented on a Commercial Off-The-Shelf (COTS) NAND Flash memory module using programming disturbances, and examine the robustness of its responses to environmental variations. In particular, we test a removable Flash memory module serving as a PUF, under nominal conditions, as well as under temperature and voltage variations. To determine its resilience to environmental variations, we utilise well-known PUF metrics, such as the Hamming weight and the intra-device Hamming distance. Our results prove that, in general, the tested Samsung K9F1G08U0E NAND Flash memory can be used to realise a lightweight, scalable, and flexible hardware security primitive, namely a PUF, that can be utilised in the context of smart homes, smart vehicles, and other smart applications, as well as to protect commercial devices and networks in general. However, voltage variations seem to pose a substantial threat to the adoption of this PUF in practice. This threat may be addressed by small-scale design improvements that should be implemented and tested in practice as part of future works.