

# Ultra-Low Power, Sub-threshold Design - From Watch Microelectronics to IoT Integrated Circuits



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**Abstract**— In the era of battery operated devices, in particular booming wearables and Internet-of-Things (IoT) objects, ultra-low energy consumption is becoming the most important challenge in the electronic design. Supply-voltage scaling is an efficient way to reduce energy by lowering the operating voltage. The reported Minimum Energy Point (MEP), in i.e. modern CMOS 65nm, can be as low as 0.35V. To achieve such low voltage operation, sub-threshold circuit design needs to be considered. Swiss watch microelectronics was exploring this approach since 1970. An overview of the principles and challenges of today's sub-threshold design will be given in this paper.

The paper depicts also the 50 years of the Swiss “Quest for the Holy Grail” in ultra low-power wearable electronics, started with the world's first electronic quartz wristwatch BETA 1 (1967) developed by the Centre Electronique Horloger (CEH) in Neuchâtel, toward autonomous, batteryless IoT objects of tomorrow.

