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Power Modeling of Complex Circuits based on Measurements; MD8710 Chip Analysis

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Abstract

This paper describes the power modeling process based on measurements and the simplified power model of a complex chip. The analyzed MD8710 chip [1] contains an ARM processor subsystem, an analog front-end, a Bluetooth with radio-frequency transceiver, a matrix display controller, digital connectivity and auxiliary peripherals. The dedicated board, the test-bench and the methods used for measurements are also presented.

The test-bench in figure 4 presents the board with the current measurement shunts; it is designed based on [2]. Some measurement results (expressed as dissipated power) are presented in the next graphs for the first switch-mode-power-supply (SMPS) in pulse-frequency-modulation (PFM) and pulse-width-modulation (PWM) modes.

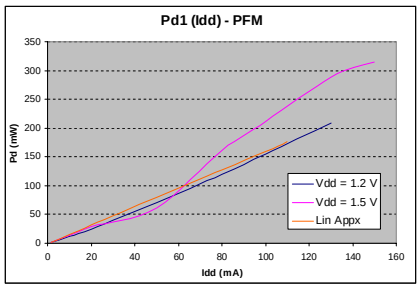

Fig. 1. SMPS1 in PFM mode

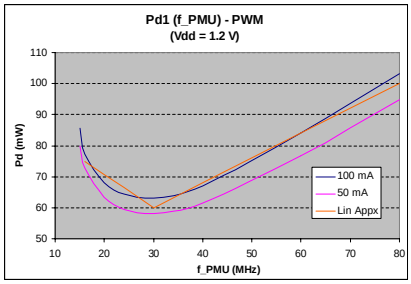

Fig. 2. SMPS1 in PWM mode, f dependence

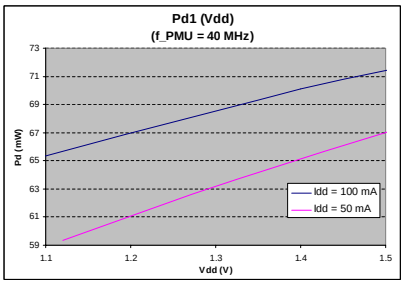

Fig. 3. SMPS1 in PWM, Vdd dependence

A simplified MD8710 power model based on the measurements was implemented in Excel; the user interface of the model is presented in figure 5. Some measurements are used directly by the model, others are used through linear (or piece-wise linear) functions that approximates the results of measurements (orange lines in figure 1 and figure 2).

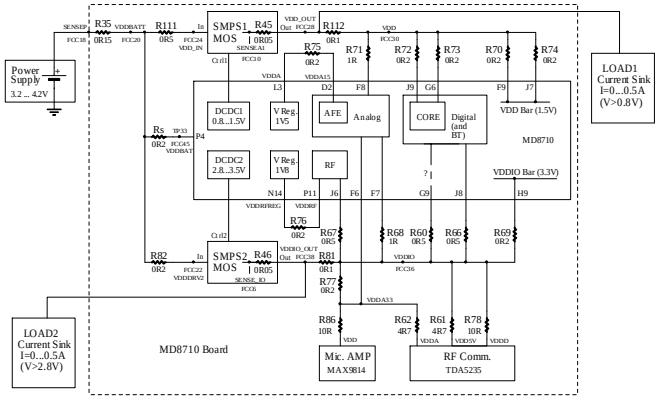

Fig. 4. Block diagram of the test board; it contains the internal blocks of the chip and all the supply path with the resistors used for current measurement

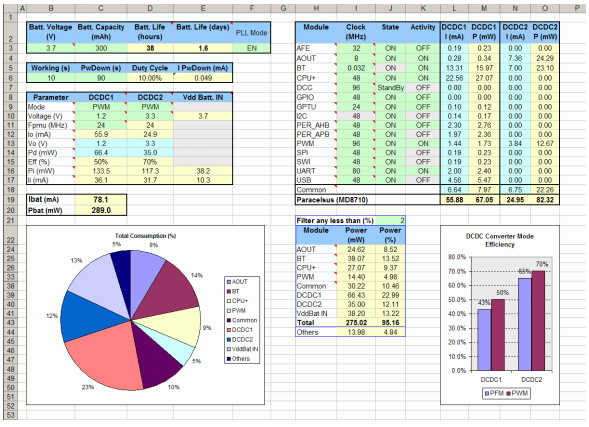

Fig. 5. User interface of the simplified power model in Excel

The original contributions of the author are: design of the test board, design and practical implementation of the test-bench, develop test procedures based on the internal chip functionalities, conceive a power model based on linearization of the characteristics for the power supplies blocks and for the analog front-end, introduce the common consumption concept and compute its parameters, implement the simplified power model in Excel. This power model can be used to compute the power consumption of the chip for scenarios with average activities of the internal blocks.

References

[1] Infineon Technologies AG – Paracelsus, Medical and Industrial Device Controller (M1366 A21) – Product Brief, Preliminary, 2010;
[2] Adrian Virgil CRĂCIUN - Electronic Devices and Circuits for Analog Electronics, Editura Universităţii Transilvania din Braşov, 2011.