IDEC Chip Design Contest

Dual-mode wireless charging system with RF energy harvesting

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Introduction

This circuit is for RF Energy harvesting SoC that has 2M harvesting range also with TEG or Solar Energy. In, 5.8GHz RF-DC Converter, with Single-Stage voltage Multiplier with parallel NMOS and PMOS, Back-to-Back Structure, and LC Boosting Self Biasing, efficiency has been improved a lot. Because of these structures, 2.4GHz RF-DC converter efficiency also has been improved by matching optimizing with new structure, Back-to-Back Structure and On-Chip Matching. In TEG Boost Converter, Low voltage boost converter and MPPT algorithm have been applied to case that input is over 300mV and Output is 1.2V, 1mA. Combiner improved by ESD PAD and Tribo Rectifier reduced its Core TR Stack numbers.

Block Schematic Architecture

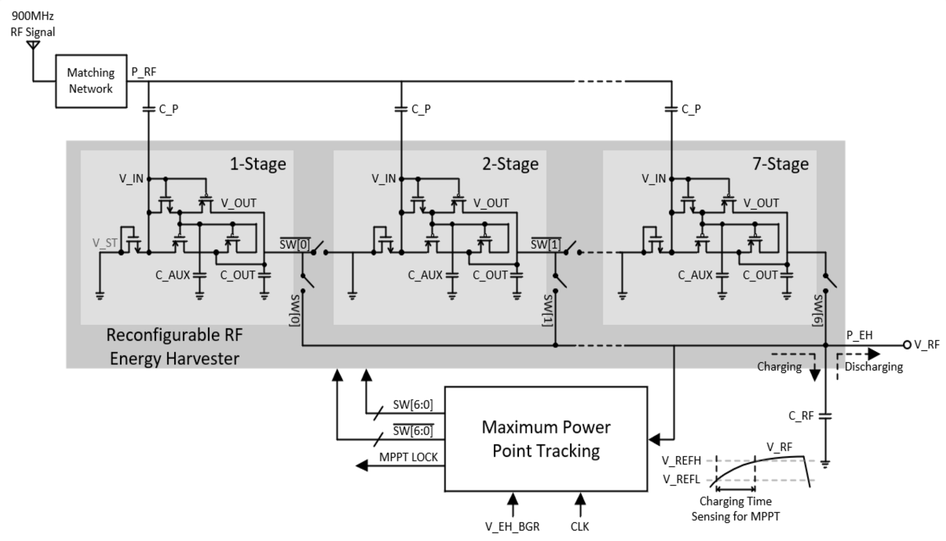

Fig1. Block diagram of the total system with proposed reconfigurable RF-DC converter with MPPT for RFEH

Reconfigurable RF-DC converters using MPPT for RFEH have been proposed by controlling and adding switches to achieve peak PCE for wide input range operation.

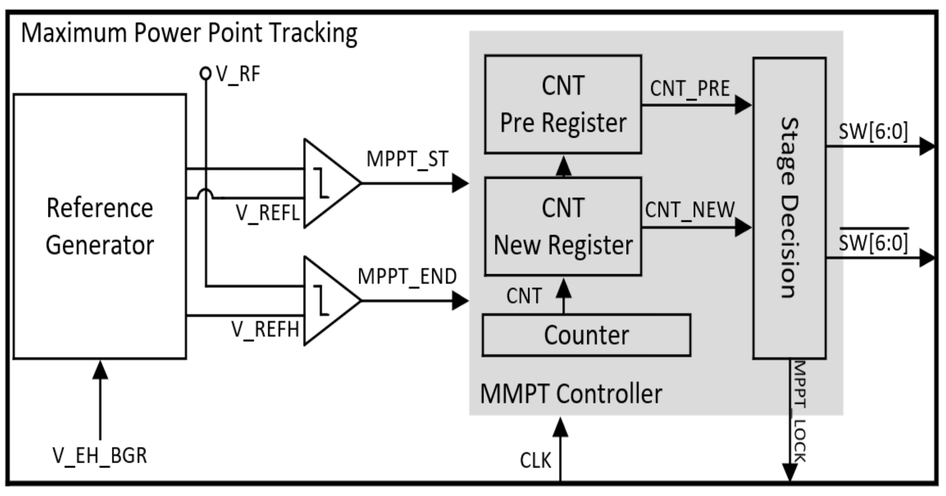

Fig 2. Block diagram of maximum power point tracking

The proposed MPPT consists of a comparator, a reference generator, and an MPPT controller. In the proposed MPPT, by the charge time of the CRF, the output power is calculated.

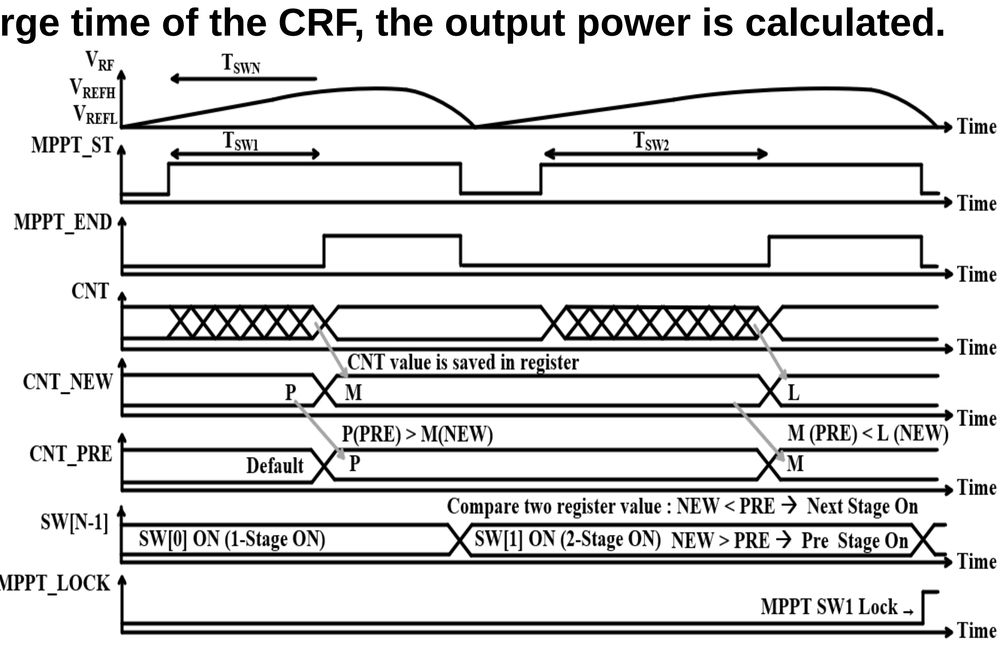

Fig 3. Timing diagram of the proposed MPPT

As shown in Fig. 3, if one stage is turned ON (AT Fig. 3 SW [0] ON), the VRF increasing time M is counted and saved in the internal counter CNT_PRE.

Experimental Results

Process	0.18 μm BCD
Energy Harvesting	RF
MPPT	Yes (RC Time)
Reconfigurable	Yes
WPR	Yes
Power efficiency	82.14%
Die area	4.2 mm * 3.1 mm

Table 1. Performance summary of this work

Conclusion

The designed structure's overall power efficiency is about 82.14%, under 100mA load conditions. When the input power level is larger than 20 dBm, the WPR path has greater efficiency than the EH path. At the input power of 30 dBm, with the WPR path, the peak efficiency is 82.1%.

Acknowledgement

The chip fabrication and EDA tool were supported by the IC Design Education Center(IDEC), Korea.

References

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