Single-ended to Differential Mode Voltage-to-Current and Current-to-Voltage Converter in High Voltage SOI Technology

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Extended Abstract

This paper presents a modified voltage-to-current and current-to-voltage converter with differential output capabilities. The new version of the converter uses single-stage signal processing for both output signals. This solution results with improved operation of the converter due to significant shortening of the longer of two signal paths that exist in the previously published circuit. The paper presents a comparison of the original and modified converter structures. In both cases, the schematics with overvoltage protection devices are used in the presented analyses.

The proposed converter is a direct redesign of the circuit presented in [1]. The possibility of similar converter designs as current-mode HV structures was mentioned in [2] and it took the form of the single-ended converter shown in Fig. 1. The circuits presented in [2] were designed and simulated in SmartIs 0.8 µm SOI (Silicon on Insulator) process provided by Atmel and developed into TeleSmart 0.8 µm by Telefunken. The first redesign was made with H35B4 0.35 µm process by AMS [9], while the most recent and most advanced redesign has been made with XDM 1.0 µm process SOI by XFAB [1].

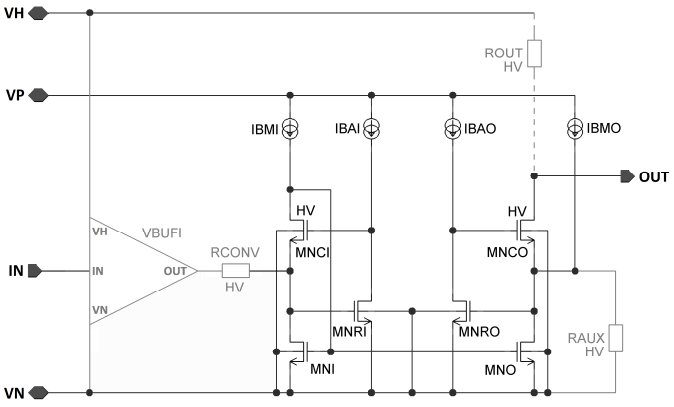

Fig. 1. Principle of operation of the single-ended converter [2].

The advantage of the proposed converter is related to significant shortening of the signal path used to generate the non-inverted output signal due to a non-standard reconnection of the input current signal (Fig. 2). The performed signal path redesign reduced number of HV MOS transistors that are used and matched to achieve quality of HV current mirror operation.

Moreover, the applied redesign splits the input voltage-to-current converter into two analogous blocks, which partially share the same current flow. The input node is now only loaded with the difference of the conversion currents of these blocks.

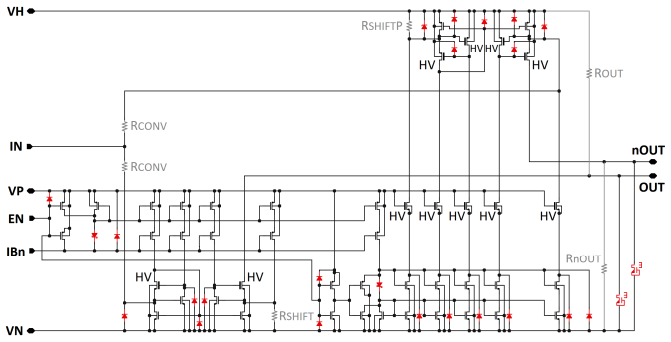

Fig. 2. Principle The proposed differential converter that is a redesign of the original structure presented in [1].

The proposed converter offers a higher frequency range of its differential output waveform. The new circuit also shows improved quality of its internal signal processing expressed as the output waveform THD value over the vast majority of its pass frequency band. Additional future actions will be taken to further tune and improve the operation and thus to extend superior features of the proposed converter.

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References

[1] M. Jankowski, “Practical Implementation of Voltage-to-Current and Current-to-Voltage Converter in High Voltage SOI Technology,” 2025 32nd International Conference on Mixed Design of Integrated Circuits and System (MIXDES), Szczecin, Poland, 2025, pp. 121-125

[2] M. Jankowski and A. Napieralski, "Current-mode signal processing implementation in HV SoI integrated systems," Microelectronics Journal, Vol. 45, Issue 7, 2014, pp. 946-959.