Contribution ID: **94** Type: **POSTER**

A Novel Source-Drain Follower for Monolithic Active Pixel Sensors

Saturday 26 September 2015 19:15 (1 minute)

Monolithic active pixel sensors or MAPs receive interest in tracking applications in high energy physics as they integrate sensor and readout electronics in one silicon die with potential for lower material budget and cost, and better performance \[1\]. Source followers (SFs) are widely used for MAPs readout: they increase charge conversion gain ($1/C_{eff}$) because the follower action compensates part of the input capacitance. Charge conversion gain is critical for analog power consumption and therefore for material budget in tracking applications, and also has direct system impact \[2\].

This paper presents a novel source-drain follower (SDF), where both source and drain follow the gate potential further improving charge conversion gain. For the Inner Tracking System (ITS) upgrade \[3\] of ALICE experiment at CERN, low material budget is a primary requirement. The circuit was studied as part of the effort to optimize the effective capacitance of the sensing node. Collection electrode, input transistor and routing metal all contribute: reverse sensor bias reduces the collection electrode capacitance. The novel SDF circuit eliminates the contribution of input transistor, reduces the routing contribution if additional shielding is introduced, and has a voltage gain closer to unity than the standard SF. The SDF circuit is somewhat larger with somewhat lower bandwidth, but this is acceptable in most cases.

A test chip, manufactured in a 180 nm CMOS image sensor process, implements small prototype pixel matrices in different flavors to compare readout with standard SF, novel SDF, and novel SDF with additional shielding. The effective sensing node capacitance was measured using a ^{55}Fe source. Increasing reverse substrate bias from 1 to 6 V reduces the overall sensing node capacitance for the standard SF by 38%. The SDF provides a further 9% improvement. The SDF circuit with additional shielding provides 18% improvement, and combined with 6V reverse bias yields almost a factor 2.

Author: GAO, Chaosong (Central China Normal University CCNU (CN))

Co-authors: JUNIQUE, Antoine (CERN); MARIN TOBON, Cesar Augusto (Autonomous University of Puebla (MX)); KIM, Daehyeok (Yonsei University (KR)); REIDT, Felix (Ruprecht-Karls-Universitaet Heidelberg (DE)); AGLIERI RINELLA, Gianluca (CERN); HILLEMANNS, Hartmut (CERN); MUGNIER, Herve; VAN HOORNE, Jacobus Willem (Vienna University of Technology (AT)); ROUSSET, Jerome; SIELEWICZ, Krzysztof Marek (Warsaw University of Technology (PL)); MUSA, Luciano (CERN); MAGER, Magnus (CERN); KEIL, Markus (CERN); KOFARAGO, Monika (Nikhef National institute for subatomic physics (NL)); MARTINENGO, Paolo (CERN); RIEDLER, Petra (CERN); YANG, Ping (Central China Normal University CCNU (CN)); LEE, Seongjoo (Yonsei University (KR)); KUGATHASAN, Thanushan (CERN); SNOEYS, Walter (CERN)

Presenter: GAO, Chaosong (Central China Normal University CCNU (CN))

Session Classification: After dinner POSTER session, with drinks: (All presenters are requested/encouraged to attend their posters; All participants are requested to participate the session, with drinks!)

Track Classification: Pixels (including CCD's) - Charged particle tracking