Ultra-low noise mixed-signal chip improves performance in Siemens X-ray computed tomography scanner

ams announced that it is supplying a highly integrated ASIC which enables a new Siemens photo-detector module for computer tomography (CT) to deliver higher resolution images at lower X-ray dosages.

The ams ASIC, which is part of Siemens' new Stellar CT photo-detector module, captures and digitizes images of a patient's body. It combines a high-resolution photodiode with a low-noise ADC in a stacked-dice (3D-integrated) configuration.

The ASIC from ams is the result of collaboration with Siemens that began in 2005 which was aimed at producing a new generation of photo-detector module offering radically improved performance in line with the demand from oncologists and other medical professionals.

Medical professionals have two key requirements for new CT equipment:

· Higher resolution images, which allow for more accurate diagnoses of patients' conditions

· Lower X-ray dosage, which reduces the health risk to patients when undergoing a scan

The ASIC has delivered a breakthrough in analog sensor performance, dramatically reducing noise in the sensitive analog signal chain between the photo-diode and the ADC. In order to produce such a marked improvement in performance, the ASIC development project drew on a broad range of capabilities at ams. These include:

· Unique ams IP. An innovative two-stage ADC eliminates the dead time that is inherent in the operation of many ADCs, and therefore is able to sample the entire input signal. This maximizes the linearity of the output.

· Sophisticated gain and offset correction, supporting the production of highly accurate outputs across a wide dynamic range of optical inputs.

· Fine-tuning of transistor behavior to minimize noise. The ASIC die is fabricated at the ams wafer fabrication plant in Graz, Austria, and knowledge about the company's processes contributed to important aspects of the device's circuit design.

· Application of new fabrication techniques to enable 3D integration of a mixed-signal device. The stacked-dice technique implemented by ams integrates the photo-sensor and the ADC, replacing a long board-level track from sensor to ADC in the previous generation of detector module with a 200-µm through-silicon via. This enabled Siemens to reduce the effect of noise and crosstalk on sensitive analog signals.

The dramatic improvements in linearity, noise reduction and speed in the ams ASIC are reflected in the substantial gains in performance of the new Stellar photo-detector module over the previous-generation product it replaces. According to Siemens, the new Stellar detector offers:

· 20% lower noise in low-dose scans compared to conventional detectors

· Image resolution as fine as 0.5 mm, an improvement of 0.3 mm over conventional detectors

· Extended dynamic range, supporting the wider use of low-dose scans

· Typical power consumption reduced from 1,000 W to 300 W. This also reduces heat generation, further improving signal quality and image resolution.

According to Siemens Healthcare, in the Stellar detector, "Siemens has combined the photodiode and the ADC in one application-specific integrated circuit (ASIC) for the first time in the history of CT, reducing the path of the signal. The new ASIC

consumes 85% less power and dissipates less heat, further reducing electronic noise.”

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