Satellite-based exploration of the Earth's magnetosphere

Advanced electronics developed for ultra-precise measurements of the Earth's magnetosphere captures stunning early results

Unterpremstaetten, Austria (3 June, 2015). The Full Service Foundry division of ams AG (SIX: AMS), a leading provider of high performance analog ICs and sensors, Fraunhofer Institute for Integrated Circuits IIS and the Space Research Institute (Institut für Weltraumforschung, IWF) of the Austrian Academy of Sciences (Österreichische Akademie der Wissenshaften, OeAW) today presented the very promising results of its highly accurate measurements of the Earth's magnetosphere from space.

As part of NASA's „Magnetospheric Multiscale" mission launched in March 2015, four identically equipped satellites are performing highly accurate three-dimensional measurements of the Earth's magnetosphere. The ambitious goal of this mission is to explore the dynamics of the magnetosphere, measuring with extreme accuracy very small variations in the Earth's magnetic field. The research effort spearheaded by the Space Research Institute (based in Graz, Austria) is focused on the so-called magnetic reconnection, which is a physical process in which the Earth's magnetic energy is converted to kinetic energy, thermal energy, and particle acceleration. Magnetic reconnection is one of the mechanisms responsible for the aurora, as well as for temporary disturbances in the Earth's magnetosphere.

Like all measurement instruments and equipment in satellites, the Space Research Institute's magnetometer has to be as small and light as possible, while consuming very little power. In addition, it must offer very high accuracy under harsh conditions such as very low temperatures and radiation.

Developed by the Fraunhofer Institute for Integrated Circuits IIS in co-operation with the Space Research Institute, a tiny custom application specific integrated circuit (ASIC) enables the satellites' digital flux-gate magnetometer (DFG) to acquire highly accurate three-dimensional measurements of the magnetosphere while drawing ultra-low current. The DFG sensor was supplied by the University of California, Los Angeles. Operating at a resolution of 10 picoTesla, which is several thousand times more sensitive than a conventional electronic compass, the device is able to sense the smallest variations in magnetic flux.

The Fraunhofer ASIC was fabricated by ams on its specialty 0.35µm CMOS (C35) process technology, which allows for the design of complex analog/mixed-signal integrated circuits. Based on a unique process architecture, the rad-hard C35 technology is very well suited for use in space and aerospace applications. The Fraunhofer and Space Research Institute design team also benefited from ams' turnkey solutions for IC design, which include a comprehensive Process Development Kit

(PDK) and IP block portfolio, advanced process technologies as well as product qualification services and supply chain management capabilities. These enable ams' foundry customers to significantly mitigate their development risks and to reduce the duration of the development cycle.

"The ams specialty 0.35µm CMOS process enabled the team of researchers and scientists at Fraunhofer IIS to develop a complex analog/mixed-signal integrated circuit that impressively outperformed our expectations in all respects – performance, power consumption, die area and reliability", said Johann Hauer, project manager for ASIC Development at Fraunhofer IIS.

"After two months in space, we are very proud to confirm that the chip-based magnetometer significantly surpasses the requirements of accuracy and stability", commented Werner Magnes, deputy director at the Graz Space Research Institute.

„During almost 25 years of co-operation with Fraunhofer IIS, ams has successfully developed a vast number of complex integrated circuits for both research as well as industrial programs. We are happy that integrated circuits manufactured by ams now operate reliably in outer space and contribute to a better understanding of the Earth's physics" stated Markus Wuchse, general manager of ams' Full Service Foundry division.

About the Full Service Foundry division of ams

The Full Service Foundry division of ams has successfully positioned itself in the analog/mixed-signal foundry market. Its process technology portfolio includes 0.18µm and 0.35µm specialty technologies based on ams' analog, mixed-signal, high-voltage and RF processes. With its 'More than Silicon' initiative, ams offers a comprehensive service and technology package that goes beyond industry-standard foundry services. It includes leading-edge technology extensions such as 3D ICs using Through Silicon Vias, color coating, back end process customization, WLCSP and many more. Superior support during the design phase, high-end tools and experienced engineers, silicon-proven high-performance analog IP blocks, assembly and test services for turnkey solutions complete the Full Service Foundry package.

About ams

ams is a global leader in the design and manufacture of advanced sensor solutions and analog ICs. Our mission is to shape the world with sensor solutions by providing a seamless interface between humans and technology. ams' high-performance analog products drive applications requiring extreme precision, dynamic range, sensitivity, and ultra-low power consumption. Products include sensors, sensor interfaces, power management and wireless ICs for consumer, communications, industrial, medical, and automotive markets.

With headquarters in Austria, ams employs over 1,700 people globally and serves more than 8,000 customers worldwide. ams is listed on the SIX Swiss stock exchange (ticker symbol: AMS). More information about ams can be found at www.ams.com.

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About Fraunhofer Institute for Integrated Circuits IIS

The Fraunhofer-Gesellschaft is the leading organization for applied research in Europe. Its research activities are conducted by 66 institutes and research units at locations throughout Germany. The Fraunhofer-Gesellschaft employs a staff of nearly 24,000, who work with an annual research budget totaling more than 2 billion euros.

The Fraunhofer Institute for Integrated Circuits IIS is one of the world's leading application-oriented research institutions for microelectronic and IT system solutions and services. It ranks first among all Fraunhofer Institutes. With the creation of mp3 and the co-development of AAC, Fraunhofer IIS has reached worldwide recognition. In close cooperation with partners and clients the Institute provides research and development services in the following areas: Audio & Multimedia, Imaging Systems, Energy Management, IC Design and Design Automation, Communication Systems, Positioning, Medical Technology, Sensor Systems, Safety and Security Technology, Supply Chain Management and Non-destructive Testing.

About 880 employees conduct contract research for industry, the service sector and public authorities. Founded in 1985 in Erlangen, Fraunhofer IIS has now 12 locations in 10 cities: Erlangen (headquaters), Nuremberg, Fürth, Dresden, further in Bamberg, Waischenfeld, Coburg, Würzburg, Ilmenau and Deggendorf. The budget of 120 million euros is mainly financed by projects. 23 percent of the budget is subsidized by federal and state funds.

About the Graz Space Research Institute

The Graz Space Research Institute (Institut für Weltraumforschung, IWF) of the Austrian Academy of Sciences (Österreichische Akademie der Wissenschaften, ÖAW) focuses on the physics and exploration of the solar system, covering the whole chain of research needed in its fields: from developing and building space-qualified instruments to analyzing and interpreting the data returned by these instruments. In terms of science, IWF concentrates on space plasma physics, on the upper atmospheres of solar system bodies and exoplanets, and on the Earth's and the Moon's gravity field.

Presently, IWF Graz is involved in fifteen international space missions, led by the European Space Agency (ESA), or by national space agencies in the US (NASA), Japan, Russia, and China. The missions cover fleets of satellites in near-Earth space, observation of the Sun, exploration of planets inside and outside our solar system, as well as orbiting and landing on comets.

More information: www.iwf.oeaw.ac.at

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for further information

Media Relations

ams AG
Ulrike Anderwald
Marketing Communications
T +43 (0) 3136 500 31200
press@ams.com
www.ams.com

Technical Contact

ams AG
Andreas Wild
Senior Marketing Manager, Full Service Foundry
T +43 3136 500 31246
andreas.wild@ams.com
www.ams.com

Fraunhofer Institute for Integrated Circuits IIS
Thoralf Dietz
Head of Corporate Communications
T +49 9131 776-1630
thoralf.dietz@iis.fraunhofer.de
Am Wolfsmantel 33
91058 Erlangen
Germany
www.iis.fraunhofer.de

Klaus Taschka
Editorial notes
T +49 9131 776-4475
klaus.taschka@iis.fraunhofer.de

www.iis.fraunhofer.de

Austrian Academy of Science
Space Research Institute
Alexandra Scherr
Public Relations
T +43 316 4120 414
alexandra.scherr@oeaw.ac.at
www.iwf.oeaw.ac.at

Dr. Werner Magnes
Deputy Director and Head of Magnetometer Laboratory
T +43 316 4120 562
werner.magnes@oeaw.ac.at
www.iwf.oeaw.ac.at