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Fully integrated galvanic isolation interface in GaN technology

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Gallium Nitride (GaN) High Electron Mobility Transistors (HEMTs) are very promising devices for both switching and RF power applications, thanks to the inherent material properties, such as the wide bandgap and the high mobility, of the two-dimensional electron gas (2DEG) generated at GaN/AlGaN interface. These characteristics allow transistors with higher breakdown, faster switching speed, and lower on-resistance than silicon ones.

In recent years, the GaN technology has been improved to push up power conversion efficiency so that GaN HEMTs are becoming more and more common discrete devices.

Moreover, to enhance performance of GaN power switches a fully integrated circuit (IC) approach has been attempted through the implementation on the same substrate of low-power and high-power GaN transistors, thus overcoming the performance limitations due to parasitic inductances between driver and power switch. This solution minimizes losses and allows higher switching speed, efficiency, and compactness to be achieved. However, the current GaN technology presents several limitations mainly due to the absence of low-power p-channel transistors and wide electrical parameter spread.

An important requirement of many switching power systems is galvanic isolation, which makes compliant a wide range of application areas (e.g., medical, smart-home systems, electric vehicles, industrial instrumentations, etc.) with safety and reliability standards.

This poster presents a monolithic galvanic isolation interface in a 0.5-GaN technology, experimentally demonstrated. It is based on a chip-to-chip RF communication and magnetically coupled micro-antennas, which allow high isolation rating to be achieved.

The isolation interface consists of two channels, namely the driver control channel and the power supply control channel. Each channel of the isolation interface adopts an RF front-end that is composed of a transmitter (TX) and receiver (RX). The driver control channel is used to drive a power switch through a driver stage to implement a dc-ac switching power converter. The power supply control channel performs the feedback path of a dc-dc power converter (i.e., a flyback dc-dc converter) that provides the isolated power supply for the power chip. It includes also a Pulse Width Modulation Generator (PWM) circuit and a soft start up circuit.