PSiP Micromodules with Integrated Inductor for Point-of-Load Applications

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ABSTRACT

- This poster presents development of power micromodules suitable for point-of-load applications.
- Micromodule as power system in package (PSiP) with an integrated inductor.
- Micromodule is a step-down type of DC-DC converters with adjustable output voltage.
- The output current of the modules are 600mA.
- Micromodule is very small with nominal dimensions of 3.2 mm x 2.5 mm x 1.6 mm.
- In the same package, the integrated circuit (IC), inductor and capacitors is integrated.
- The base of the micromodules is the ceramic substrate, which serves at the same time as inductor.

INTRODUCTION

- Recent trends in power electronics are miniaturization and integration of power supplies, especially for mobile and portable devices.
- Permanent increase of the switching frequency allows not only for miniaturization but also the integration of discrete components in the module.
- The final target is development of new miniaturized and integrated products known as power supply in package (PwrSiP) and power supply on chip (PwrSoC) with the aim to reduce size and cost.

DESIGN OF MICROMODULES

- Key part of the micromodule is the substrate, therefore the fabrication technology is developed and optimized.
- The substrate fabrication is based on thick-film technology.
- The ferrite substrate is the most complex part of the module, consisting of the embedded inductor and routing (connections between top side of the substrate and bottom side).
- Connection through the ferrite shows high parasitic inductance, which can negatively affect the performance of the DC-DC converter.
- To reduce parasitic inductance of the routing, connections between the top and bottom sides of the substrate are moved to the corner of substrate.
- Using this approach the micromodule (DC-DC converter) shows high efficiency and stable functionality.
- The design of the micromodule is shown in Fig. 1. On top of the ferrite substrate the IC and capacitors are mounted. One capacitor is input and one output capacitor.
- Integrated capacitors features only a portion of needed capacitance.

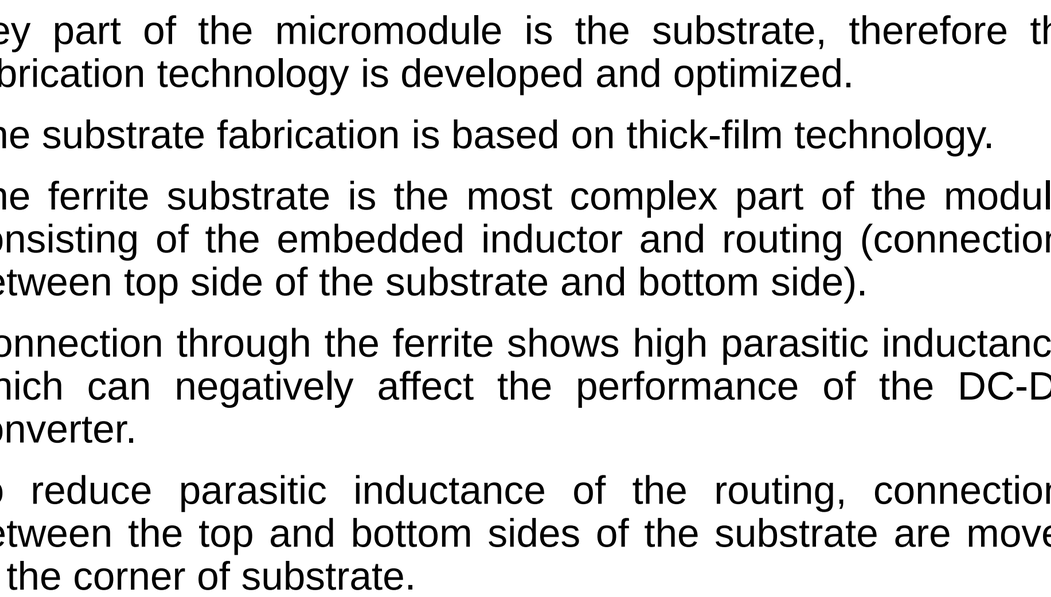

Fig. 1: Design of micromodule, top and bottom side

DESIGN OF MICROMODULES

- The construction of the module is detailed shown in the Fig.2 (X-ray micrograph) and Fig.3 (cross-section of modules).

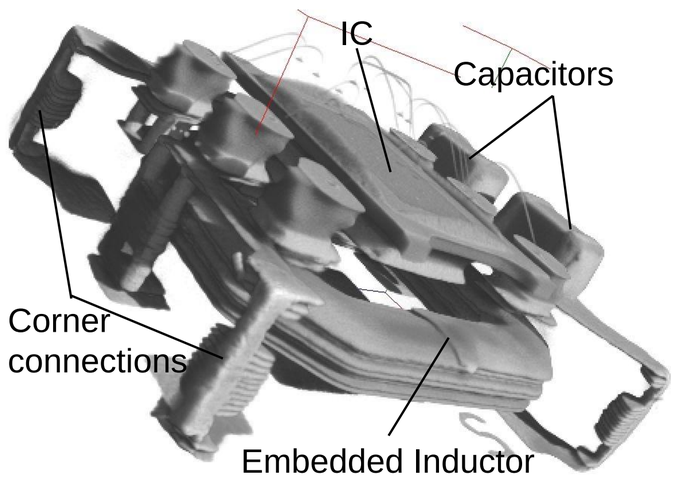

Fig.2: X-ray micrograph of completed micromodule

Fig.3: Cross-section of completed micromodule

ELECTRICAL PROPERTIES

- The power module is suitable for point-of-load application.
- Main features of the module is summarized in the Table I

Table I: Electrical specification of power module

	Design A (two caps)
Type	Voltage mode buck converter
Switching frequency [MHz]	2.25
Input voltage [V]	2.7 – 5.5
Output Voltage [V]	0.6 – 5.5
Output current [A]	0.6
Peak efficiency [%]	96

ELECTRICAL MEASUREMENTS

- Fig.4 shows efficiency for power module at input voltage of 5.5V and output voltage of 3.3V. The efficiency of about 92% is measured. Red line shows a voltage regulation Vout vs. Iout for input voltage of 5V.

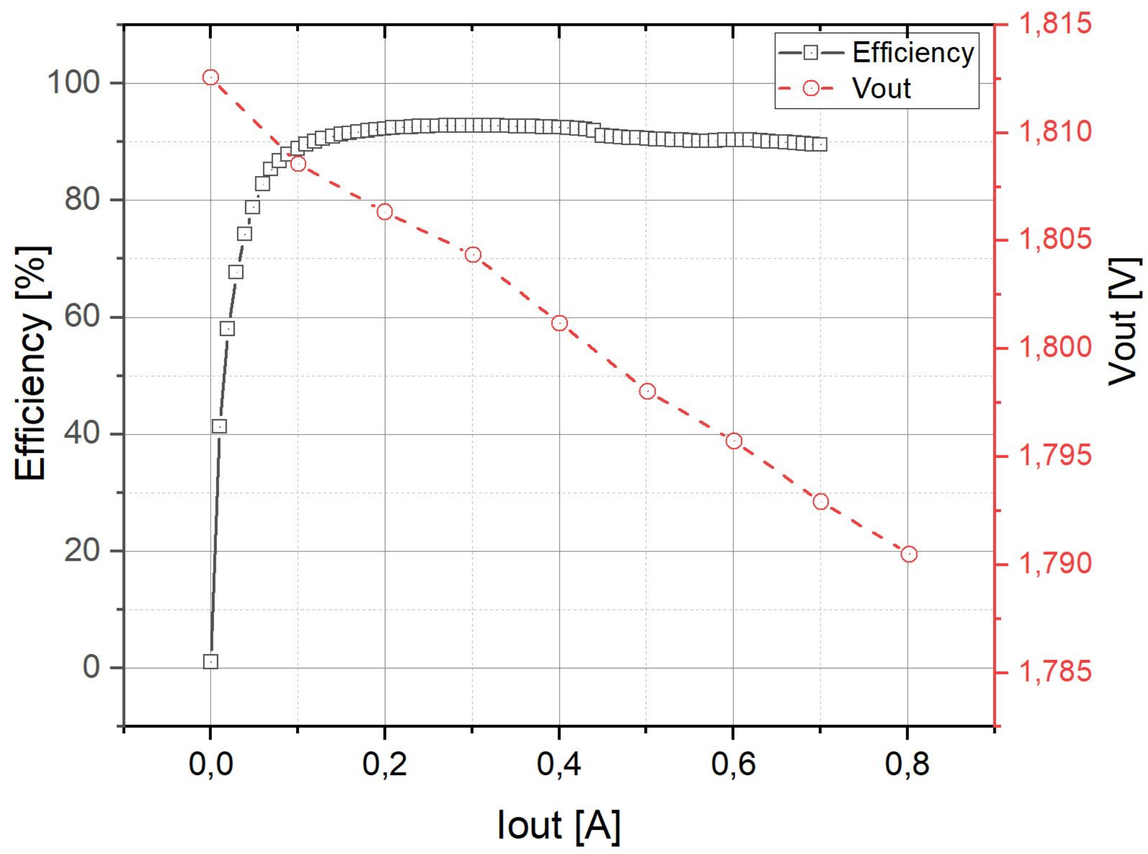

Fig.4: Efficiency characteristic of micromodule for input voltage of 5.5V at output voltage of 3.3V

- New approach for reducing parasitics using corner connections allows good performance and high efficiency of the micromodule.

CONTACT

- For question please contact us: powermodules@we-online.de