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Custom Designed Discrete Microinductors and Microtansformers Fabricated on Silicon for High Frequency Applications

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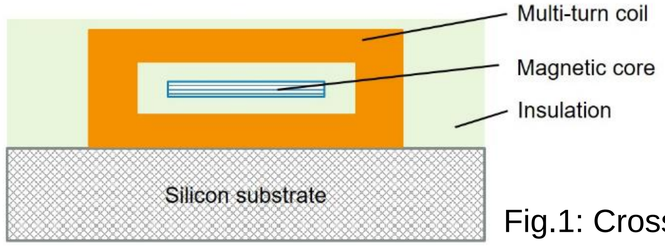
INTRODUCTION

- Miniaturization & integration is main market requirements for electronic devices
- Magnetic parts are often the largest component in the applications. For new electronics devices also new magnetic components are required.
- One way for miniaturization is increasing the fsw. Higher fsw requires lower inductance with small size and low profile.
- Standard wire wound technology shows restrictions for further miniaturization and integration.
- Thin-film technology is a good candidate for development of new generation of magnetic components (magnetic on silicon)
- Compatibility with CMOS technology enables further integration of the system Power Supply in Package (PSiP) and Power System on Chip (PwrSoC)

DESIGN AND FABRICATION

- Developed devices have a solenoid design with open bar (rod) magnetic core and multi-turn coil surrounding the magnetic core
- Microtransformer and microinductors fabricated on 12-inch silicon wafers on mass production equipment using Far-BEoL RDL technology



- Magnetic core: 4µm thick CoZrTa (CZT) laminated
- Coil: 15µm thich Cu
- Insulation: Polyimide

Fig.1: Cross-section of solenoid design

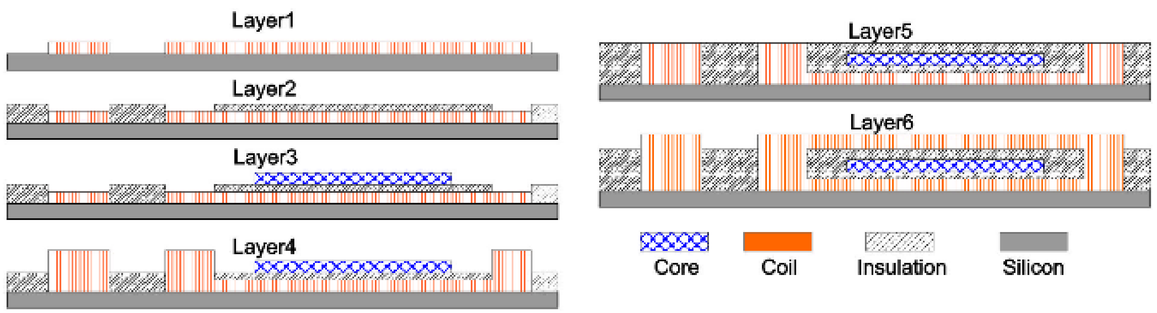


Fig.2: Fabrication steps of micro components

KEY CONTRIBUTION

WLSC packaged, fully qualified components based on AEC-Q200 grade 1 standard. Designs available on customer request

PROPERTIES & RESULTS

- Wafer Level Chip Scale Packaging technology (WLCSP) implemented for packaging. Package thickness (with balls) ~ 400µm.
- Microinductors and microtransformers are fully qualified based on AEC-Q200 grade 1 standard for temperature range (-40°C - +125°C)
- Deferent designs are available based on customer requirements

Table I: Example: properties of microinductor and microtransformer

Parameters	Value (induc.)	Value (transf.)
L	100nH @ 15MHz	82nH @ 25MHz
Rdc	0,32Ω	0,28Ω
Q-factor	15 @ 30MHz	13.7 @ 25MHz
Isat	230mA	500mA
Ir	900mA	850mA

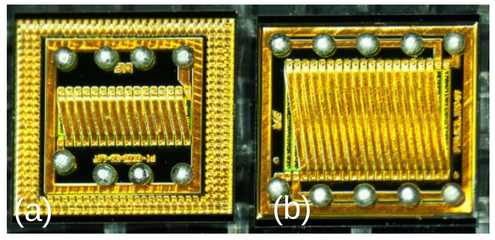


Fig.3: Microinductor (a) and microtransformer (b)

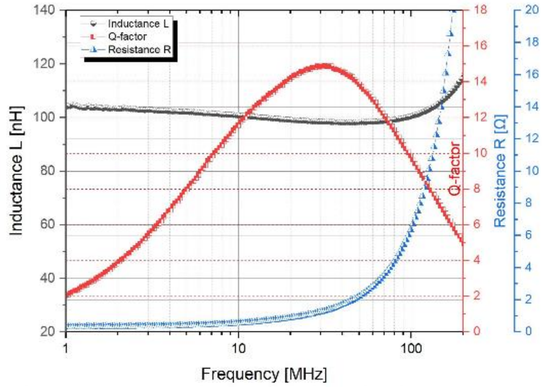


Fig.4: Properties of microinductor

- Inductance density (inductor) > 100nH/mm²
- Inductance density (transf.) > 25nH/mm²
- L/Rdc (inductor) > 400nH/Ω
- L/Rdc (transf.) >200nH/Ω

- Microtransformer tested in 20MHz non-isolated DC-DC convertor with Semtech SC220 as inductor (windings in series)
- Efficiency of 74% is achieved

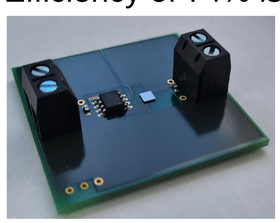


Fig.5: Test board with micro component

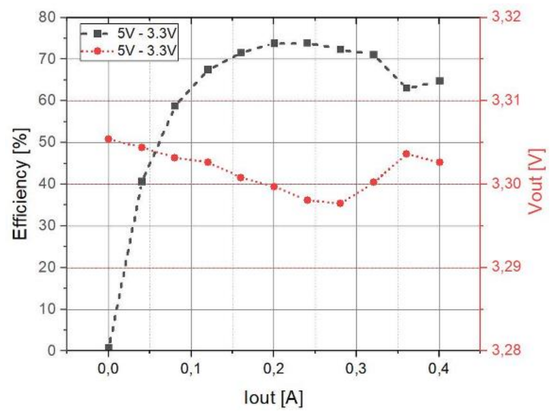


Fig.6: Efficiency & load regulation of the DC-DC converter with SC220 (5V-to-3.3V conversion)

CONTACT

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