General description

The new monolithically integrated solid-state-circuit-breaker (SSCB) is formed by a normally-on SiC-JFET and a normally-on SiC-BIFET. The SSCB is designed according to the concept of the dual-thyristor. In normal operation mode the SSCB is turned on. In case of an overcurrent, the SSCB is endowed with a regenerative turn-off capability.

Features

- Regenerative turn-off capability under overcurrents
- Overcurrent limited by the saturation current of the p-type JFET and the n-type SiC-BIFET
- Saturation current scalable by the gate-voltage
- Junction Temperature up to 175°C

Advantages

- Higher reliability and robustness over a wide range of temperatures due to SiC
- High-blocking capability (>20kV) and low on-state losses due to the SiC-BIFET
- Simplified circuit design with reduced effort on cooling and passive components
- Number of turn-off events not limited
- Customized designs regarding turn-off current and voltage rating

Benefits

- Cost savings due to reduction of passive components
- Reduced effort on mechanical fuse elements
- Higher quality of the grid and reduced voltage drops
Applications

- Substitution of mechanical Circuit Breakers and Transformer
- Protection of electrical networks and grids

Fig. 1 Simplified equivalent circuit of the new monolithically integrated SSCB consisting of a p-type SiC-JFET and an n-type SiC-BIFET

Fig. 2 Simplified equivalent circuit of the new monolithically integrated SSCB consisting of a p-type SiC-JFET and an n-type SiC-JFET

Fig. 3 Schematic cross section of the SSCB consisting of a p-type SiC-JFET and an n-type SiC-BIFET; Simple integration into an existing technology for fabricating SiC-BIFETs; Customizable dimensions

Fig. 4 Results of the measured current-voltage characteristic fabricated at IISB; Junction Temperature = 175°C

Fig. 5 Results of the numerical simulations of the current-voltage characteristic of the new SSCB