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Improvement of the operating range and increasing of the reliability of integrated circuits

Fast integrated circuits (ICs) are used in many ways in applied electronics. Especially, for hard driven fast or high-power components in the circuit, however, there is often a risk of breakdown, e.g. in oscillator circuits (radar systems, etc.) or “smart power” circuits. At the pn junctions present in all components, the breakdown occurs starting at a critical field strength. The circuit is thus destroyed or becomes unusable. To prevent this, Professor Erich Kasper and Michael Morschbach at the Institute for Semiconductor Technology of the University of Stuttgart have developed a new solution. It enables real-time monitoring of the components and prevents breakdown thanks to an integrated control unit. Currently, the breakdown can only be prevented by an external voltage or current limitation of the whole circuit (IC). In order to consider individual fluctuations of the component and temperature effects, previous solutions have sharply limited the safe operating area (SOA). Thus, in turn, the performance range could not be exploited completely. The breakdown monitoring of the invention is realized in real time by a photodiode integrated into the semiconductor part (IC). During a breakdown, a pn junction always emits optical radiation. This light emission is detected by the photodiode integrated in the immediate vicinity. Depending on this radiation detected, the voltage and current applied to the pn junction is controlled. In case of increase of the light emission of the pn junction above a limit value, the current (voltage) is reduced until the optical emissions are below the limit value again. With this control, a complete breakdown is prevented. The working point of a transistor, for example, can thus be placed immediately before breakdown. In an integrated circuit, it is possible to monitor several breakdown-prone pn junctions. The control unit can also be integrated into the semiconductor component (IC). With this monitoring, it is possible – without the risk of destruction – to expand the operating range and the power yield. In addition to greater reliability of ICs, an expansion of the operating range of the transistors and integrated circuits is thus also possible. The scattering of the component data causes no problems because an upcoming breakdown is detected and prevented and each transistor can be controlled individually at its breakdown limit. This permits optimal exploitation of the circuits, a higher operating temperature range, higher power, higher speed and a longer lifetime. The invention is especially advantageous for oscillator circuits. Today, such circuits are installed in radar devices for various manufacturers’ automotive assistance systems. For safety reasons, very great reliability is indispensable here. Reliability is also a crucial topic for applications in aviation and space technology, and for "smart power” in electromobility applications. The patents for the invention have already been granted in Germany (DE 102007002820B3), the USA (US8519732B2) and in France and Great Britain (EP Patent). Technologie-Lizenz-Büro (TLB) GmbH supports the University of Stuttgart in patenting and marketing its innovation. TLB has been commissioned by the university with the global business implementation of this

pioneering technology and offers companies possibilities to license or purchase the patents. For more detailed information, please contact Innovation Manager Dipl.-Ing. Emmerich Somlo (esomlo@tlb.de).