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DC/DC converters as linkages between photovoltaic plants and module integrated multilevel-inverters

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Abstract. In Europe photovoltaic plants are mainly working in parallel mains operation. Until now, the solar plants are usually grid connected via central inverter stations or via string inverters. The logical advancement of the string concept is the separate connection of each solar module to the grid. Therefore module integrated inverters or multilevel-inverters can be used. This concept has some advantages, as minimized mismatching losses and minimized DC wiring. But the circuit complexity is of course much higher. In this paper the layout and implementation of DC/DC-converters as linkages between solar modules and multilevel-inverters will be presented.

Keywords

Multilevel-inverter, DC/DC converter, MPP tracking, photovoltaic module, quasi resonant switching

1. Background

Usually, central inverters are used for the grid connection of large plants. The layout is cheap, as only one inverter is necessary to adapt all DC-values to the AC-grid. But high losses occur because of partial shading and different orientation of the modules [1, 2].

The string concept operates with one inverter per string. So, a more flexible layout of the solar plant is possible and the safeguarding against failure can be improved. But, similar to the central inverter, the efficiency decreases because of mismatching losses [1, 2].

Modular plants, with ideally one small inverter per module have some more advantages. As it is possible to connect each solar module separately with the grid, each module can work in its MPP. In comparison, the common string concept has just one working point for all modules connected by the string. This working point is of course worse than the MPPs of the individual modules. So, with the separate connection of the modules it is possible to increase the feed-in and as a result the income. But contrary, as the number of necessary components is very high, the investment costs increase. Also, a simple and flexible plant layout is possible and it is easy to enlarge the plant later on. So, a convenient and low priced start up with small-sized photovoltaic plants is possible. Furthermore the implementation of diagnostic systems is easy. In the long term, the fabrication of standardized devices in high numbers is possible. The low variability of the module voltages enables a convenient layout of the power electronics [1, 2].

The three different concepts for the grid-connection of solar plants are illustrated in Fig. 1.

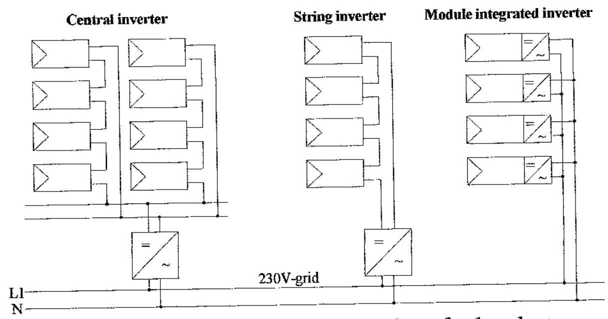

Fig. 1. Concepts for the grid connection of solar plants

The possible circuits of grid-connected self-commutating inverters are illustrated in Fig. 2. Subsequent their suitability as module integrated inverter will be discussed.

Up to now the common technology is an inverter with a power transformer. Because of the high weight and installation size of the transformer it is not usable as module integrated inverter [1, 2].