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Measuring Technique for Reducing the Number of Voltage Sensors in a Modular Multilevel Converter

Using this measuring technique, each voltage sensor is able to measure the capacitor voltages of multiple Sub-Modules (SMs) of a Modular Multilevel Converter (MMC). The proposed technique highly reduces the number of voltage sensors used in MMCs, reducing the costs and complexity of the data acquisition system. Partners to further develop the system and/or to establish commercial agreements along with technical cooperation are sought.

The Challenge

The operation of the MMC requires the use of a voltage balancing algorithm, which selects the SMs to be activated in order to maintain the SM capacitor voltages as close as possible to their reference value. This algorithm needs to know the values of all the SM capacitor voltages, which are usually obtained by direct measurement. In real applications of the MMC, the number of SMs per arm can reach to hundreds, requiring a large number of voltage sensors with their associated acquisition and processing circuitry. This compromises reliability of the MMC, besides complicating its implementation and control.

The Technology

The proposed system determines the SM capacitor voltages by using a minimum number of two voltage sensors per arm. Each voltage sensor is connected to the output of a set of series-connected SMs within each arm, acquiring the voltage measurement only when one SM of the set is activated. The acquired value corresponds to the capacitor voltage of the activated SM minus some voltage drops in the semiconductors, which can be easily estimated. Since the measurements of all the capacitor voltages are not always available, they are estimated by a mathematical model. In this mathematical model the capacitor voltage values are updated whenever there is a new measurement available. In order to ensure periodic update of each of the estimated capacitor voltages, an algorithm that enforces measurement of each capacitor voltage is proposed. Moreover, the reliability of this measuring technique can be improved by adding some redundant voltage sensors.

Innovative advantages

- Reducing the number of voltages sensors needed to measure the SM capacitor voltages in the MMC, hence reducing the direct and indirect costs.
- Reliability improvement by adding redundant voltage sensors.
- Highly tolerant to switching noise, as measures are taken between commutations.

Current stage of development

Experimental prototype and tests passed.

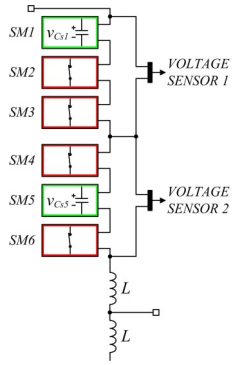
Applications and Target Market

- Measurement and data acquisition systems in MMCs.
- Fault-tolerance improvements of MMCs.
- MMC manufacturers.

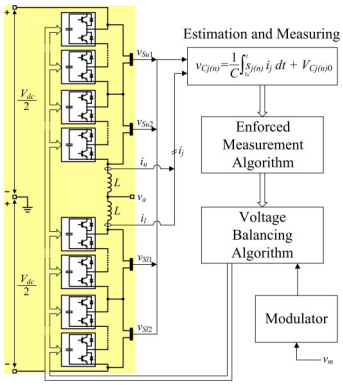
Reference number

MKTXXXXXX_I

MINIMUM OF TWO VOLTAGE SENSORS PER ARM



Voltages are acquired when only one SM in the set is activated



Capacitor voltages are estimated between measures

Business Opportunity
Technology available for licensing with technical cooperation

Patent Status
PCT application

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