



# DC-DC Converter with High Stepping Ratio

## CONTEXT

The integration of low voltage renewable energy sources into DC grids necessitates high voltage ratio DC/DC converters. With the increase of transmitted power, a commonly found problem is the magnitude of the currents on the part of the circuit close to the low-voltage terminals, often exceeding multiple times the current rating of existing power semiconductor switches. The typical front-to-front DC/DC structure using voltage source modular multilevel converter (VS-MMC) makes use of the good voltage scalability of this converter to achieve high voltage ratio. However, on the low-voltage side, the poor current scalability of the VS-MMC is a drawback, and complex solutions like using several converters in parallel would be needed.

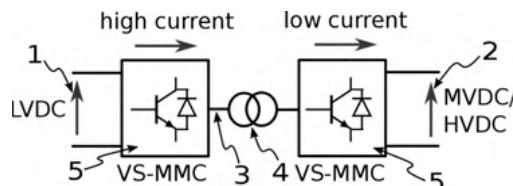


Fig.1- Generic F2F DC/DC structure using multilevel VSC converters (VS-MMC)

## TECHNOLOGY DESCRIPTION

SuperGrid Institute has patented a high voltage ratio DC/DC converter capable of handling high power levels. Low current through low voltage semiconductors is achieved without the need for several converters in parallel. The solution, designed by SuperGrid Institute, is based on the front-to-front principle but uses a current source modular multilevel converter (CS-MMC) on the low voltage side.

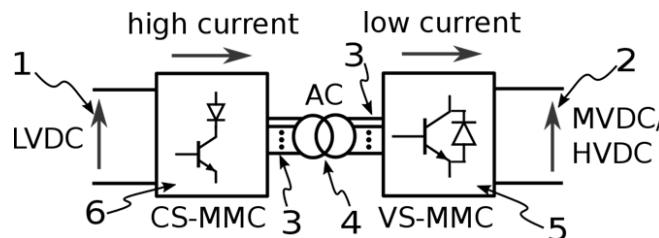


Fig.2: Proposed novel F2F DC/DC converter structure combining a CS-MMC and a VS-MMC

On its AC terminals, the CS-MMC is able to generate a stepped current waveform of very large amplitude, up to several kilo amperes, as required for the F2F DC/DC implementation. The F2F DC/DC structure is implemented by combining the current-scalable CS-MMC with the voltage-scalable VS-MMC, to perform a DC/AC/DC voltage conversion chain. Successful simulation of the converter is achieved with the following resulting current amplitudes:

	CS-MMC	VS-MMC
$I_{dc}$	4 kA	1 kA
$I_{max \text{ single switch}}$	350 A	320 A

As observed in the table, similar current amplitudes are achieved in the semiconductor switches of both converters.

## APPLICATION DOMAIN

Medium voltage and high voltage DC grids, especially for the integration of renewable energy sources into MVDC grids.

## ADVANTAGES

- Possibility to have high power level in high voltage ratio DC/DC converter
- Low current through low voltage semiconductors
- Unidirectional converter easily obtainable by replacing the high voltage side VSC-MMC by a diode rectifier

## TRL SCALE



## DELIVERABLES

Patent FR3059855 - PCT/FR2017/053351