



MULTILEVEL INVERTER FOR INDUSTRIAL APPLACTION

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Presentation Outline

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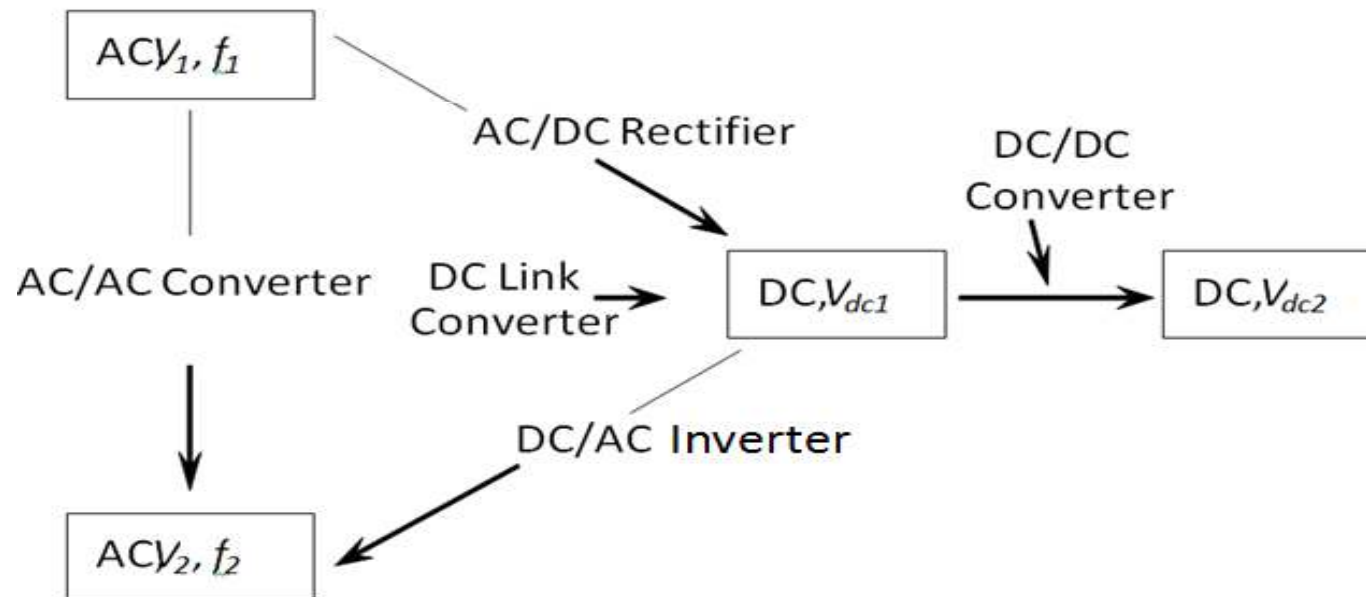
Introduction

A significant number of industrial applications have encountered a large demand for higher power components. In addition, several motor drives and utility applications require medium voltage. Modern power electronics technology has mitigated these problems by proposing the use of MLIs over conventional inverters.

Researchers today aim to eliminate harmonics and reduce cost by developing new multilevel converter topologies and new control strategies for controlling such topologies

Power electronics converters

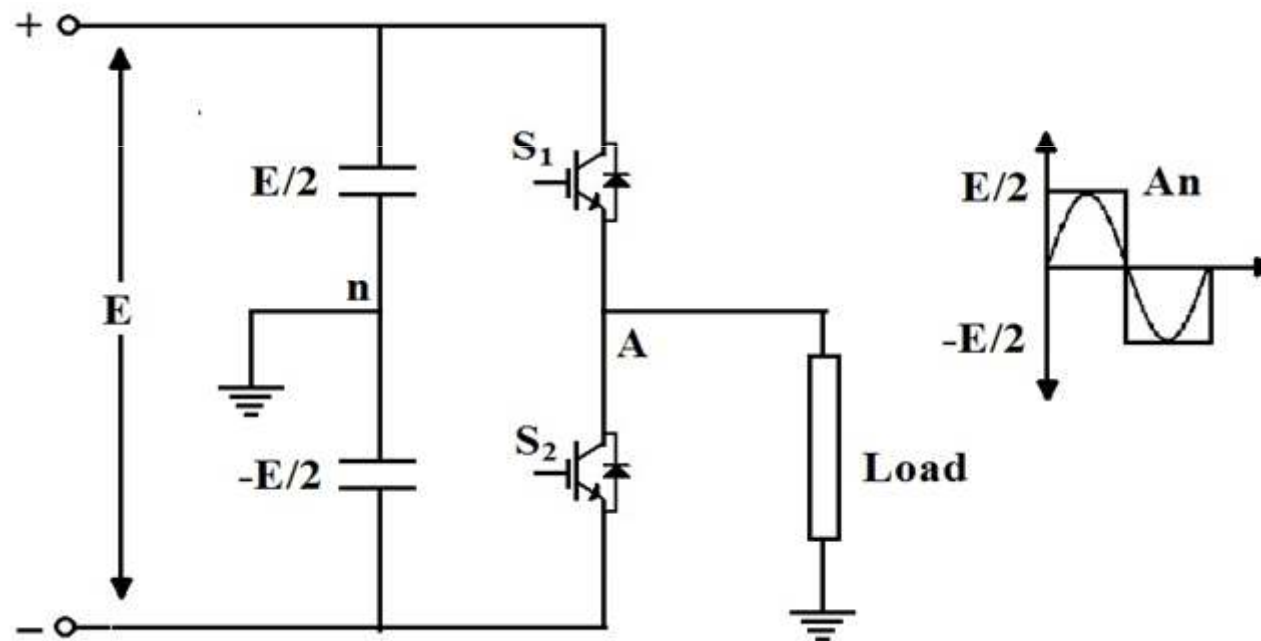
Power electronic converters use semiconductor-based electronic switches to convert one form of electrical energy to another. A classification of power electronic converters based on their electrical conversion is shown in figure below.



Families of converters categorized according to their conversion function.

Concept of multilevel inverters

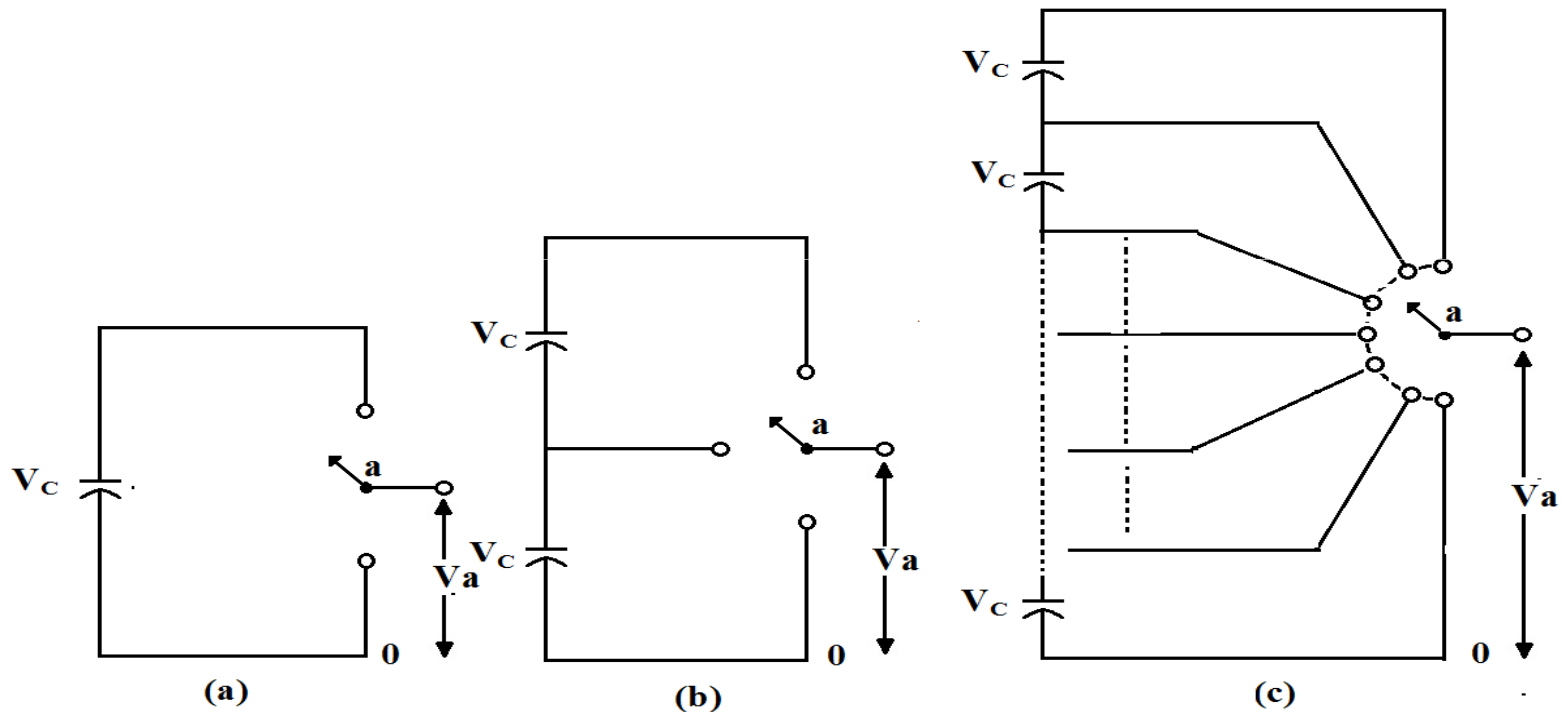
Nowadays the generation of AC voltage using conventional two-level inverters from DC voltage is a very common practice.



One phase leg of a two level inverter and a two waveform without PWM.

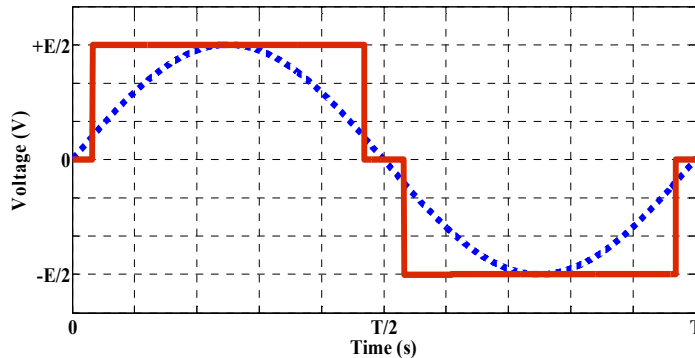
Concept of multilevel inverters

A schematic of the one-phase leg of an inverter with different numbers of levels is shown in Figure below

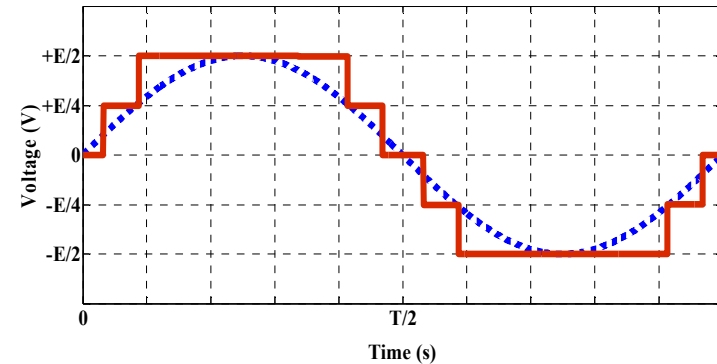


One-phase leg of inverter with (a) two, (b) three, and (c) n levels.

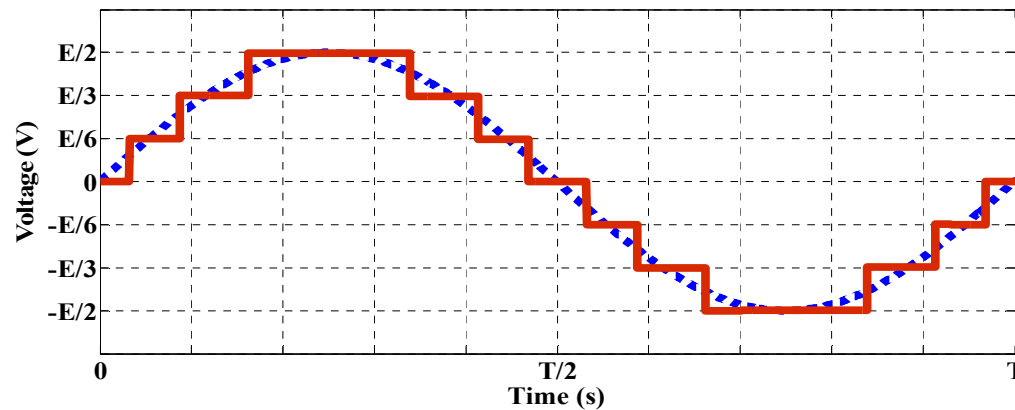
Concept of multilevel inverters



(a)



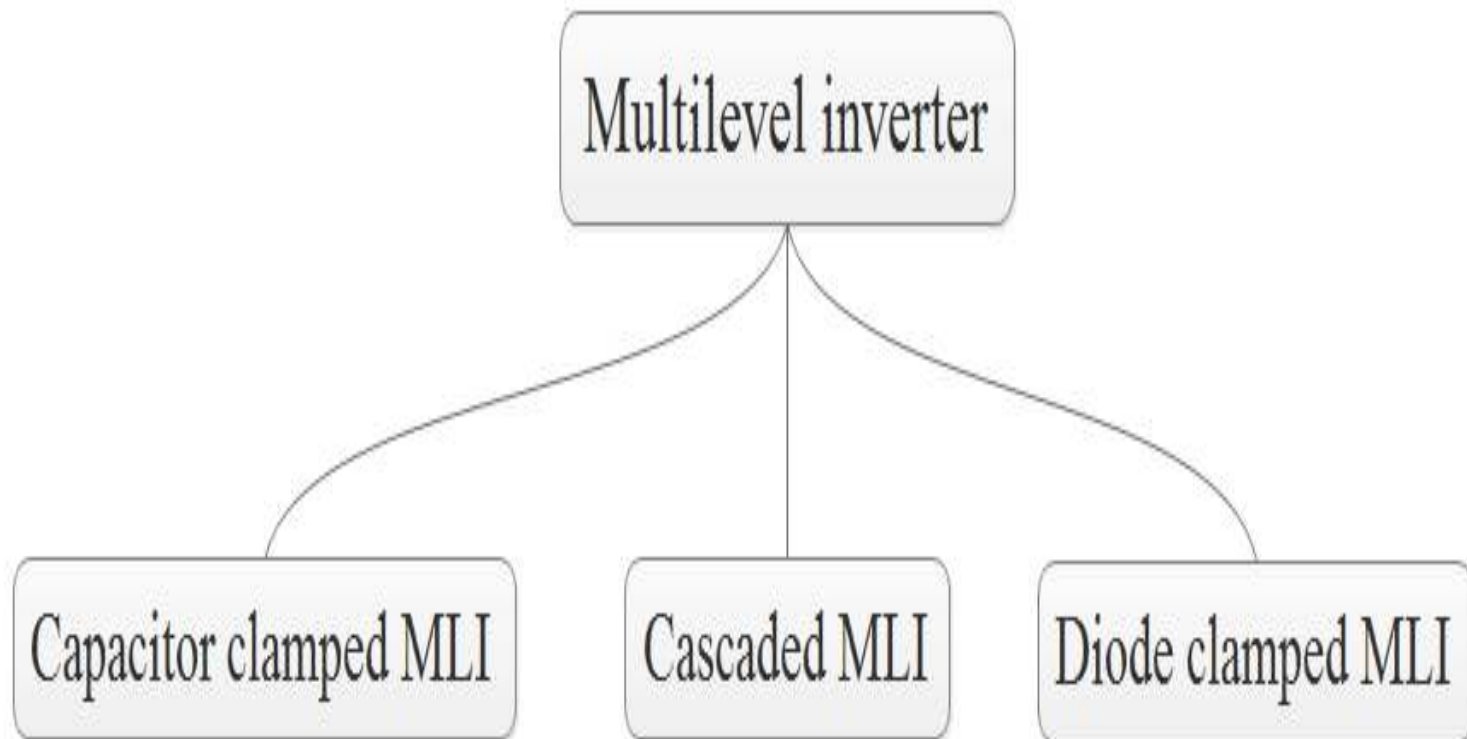
(b)



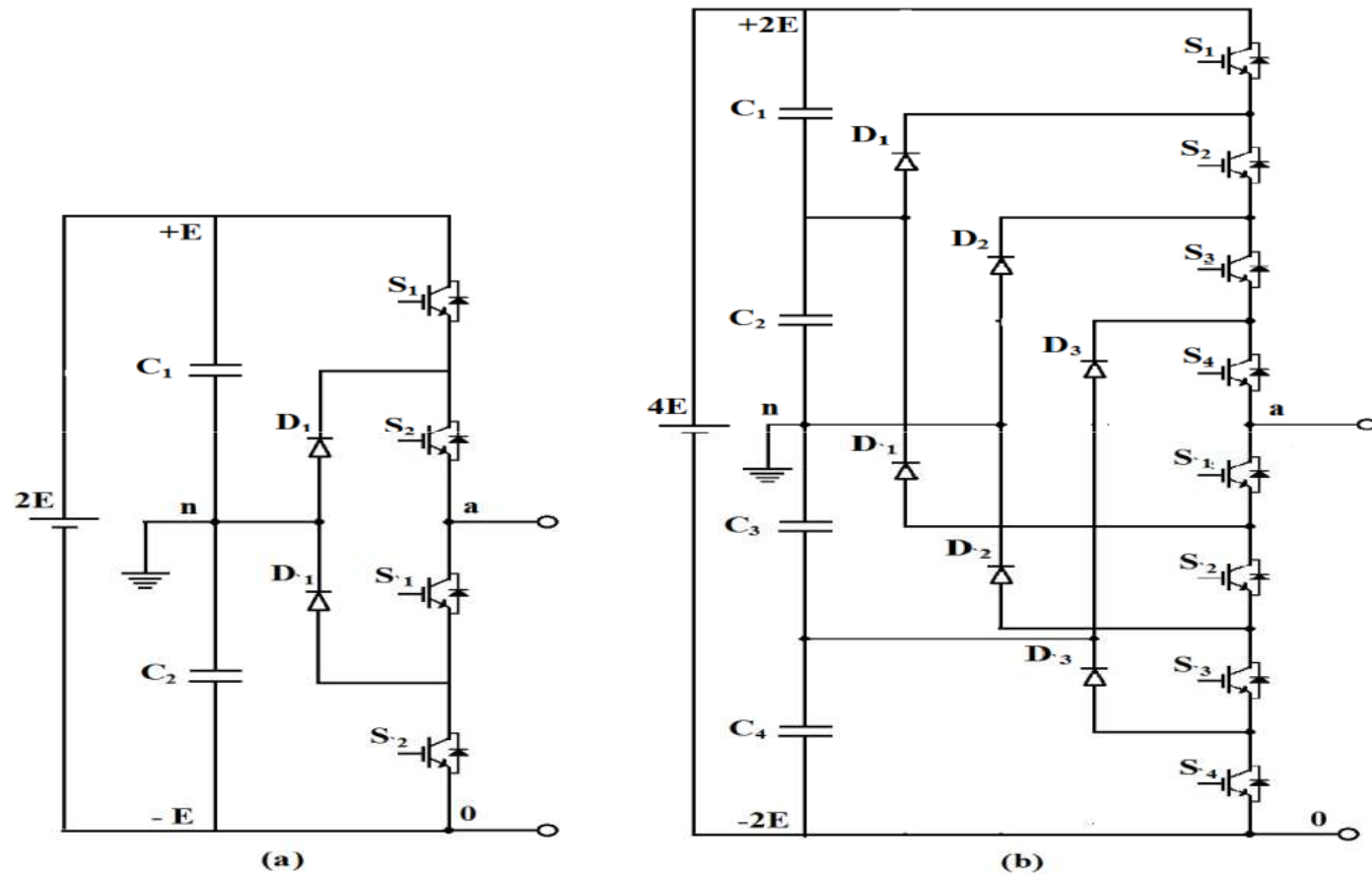
(c)

Output of multilevel inverter waveform at fundamental frequency for (a) A three-level waveform, (b) A five-level waveform (c) A seven-level waveform.

Basic multilevel inverters



Diode-clamped multilevel inverter (DCMLI)

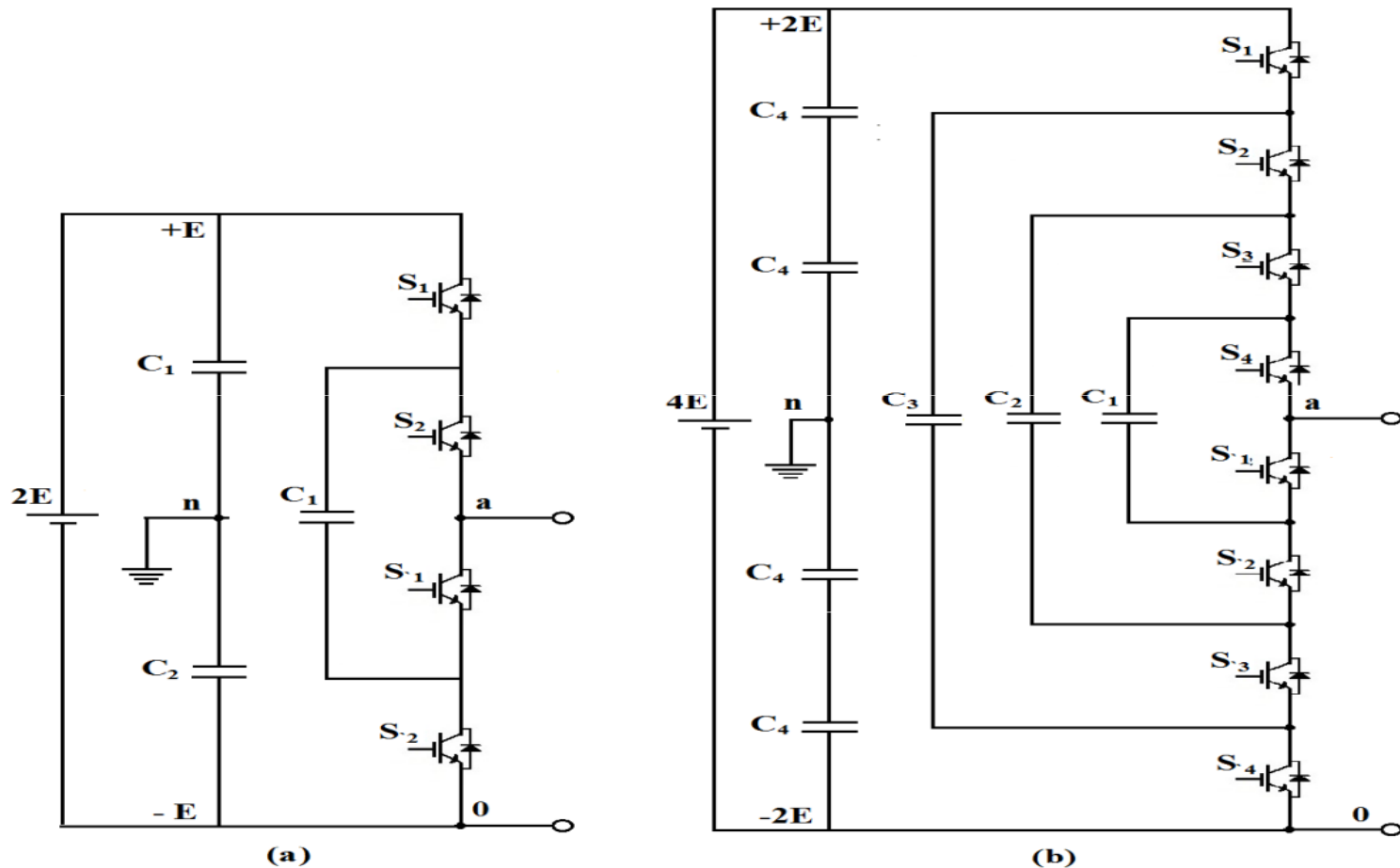


DCMLI circuit topologies: (a) three- and (b) five-level topologies.

Table possible switching configuration in a three-level DCMLI

S_1	S_2	S_1	S_2	Phase voltage (V_{an})
ON	ON	OFF	OFF	E
OFF	ON	ON	OFF	0
OFF	OFF	ON	ON	-E

Flying capacitor multilevel inverter (FCMLI)

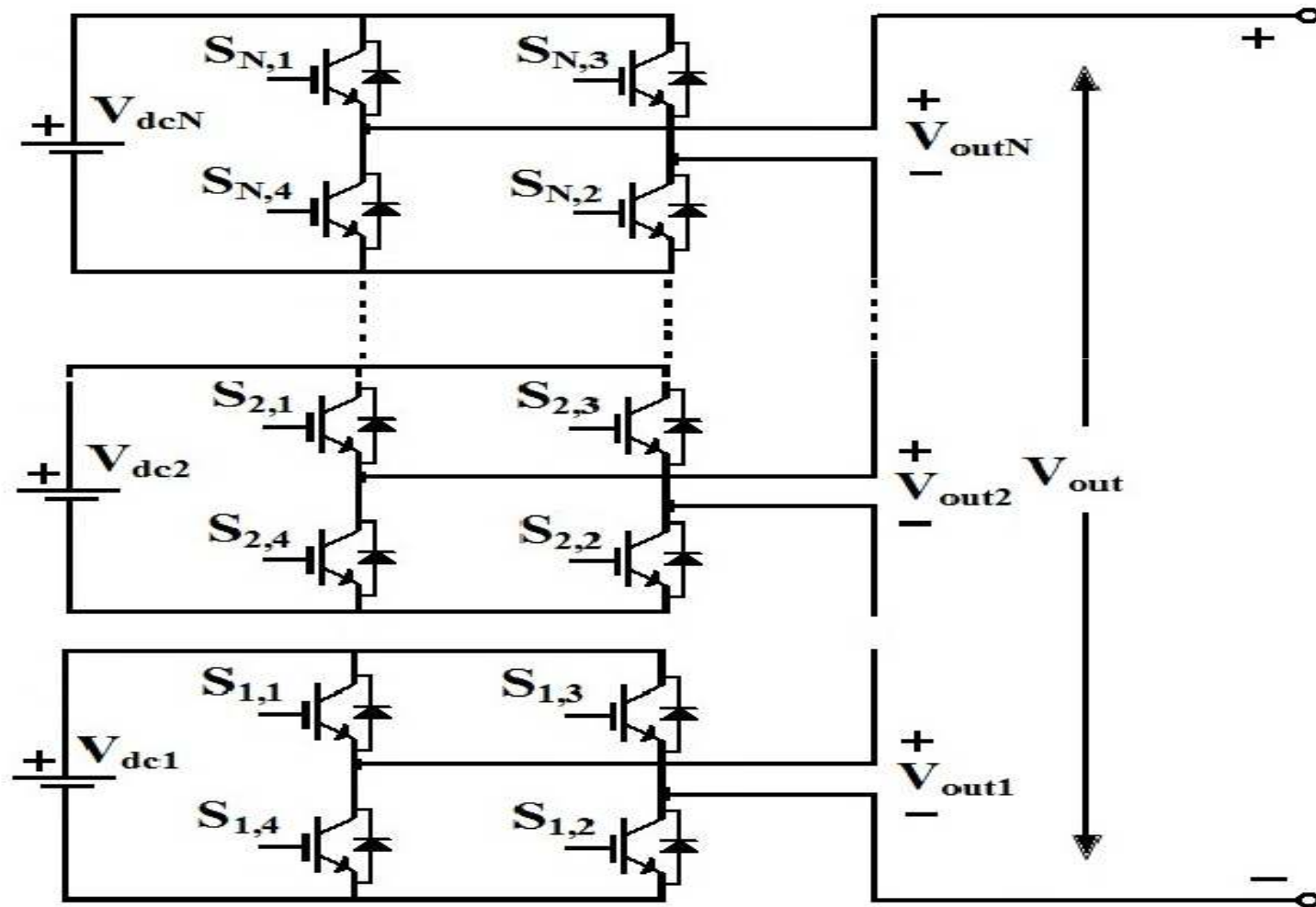


Capacitor-clamped MLI topologies: (a) three- and (b) five-level topologies.

Table possible switching configuration in a three-level FCMLI

S_1	S_2	S_1	S_2	Phase-voltage (V_{an})
ON	ON	OFF	OFF	E
ON	OFF	ON	OFF	0
OFF	ON	OFF	ON	0
OFF	OFF	ON	ON	-E

Cascade multilevel inverter (CHMLI)

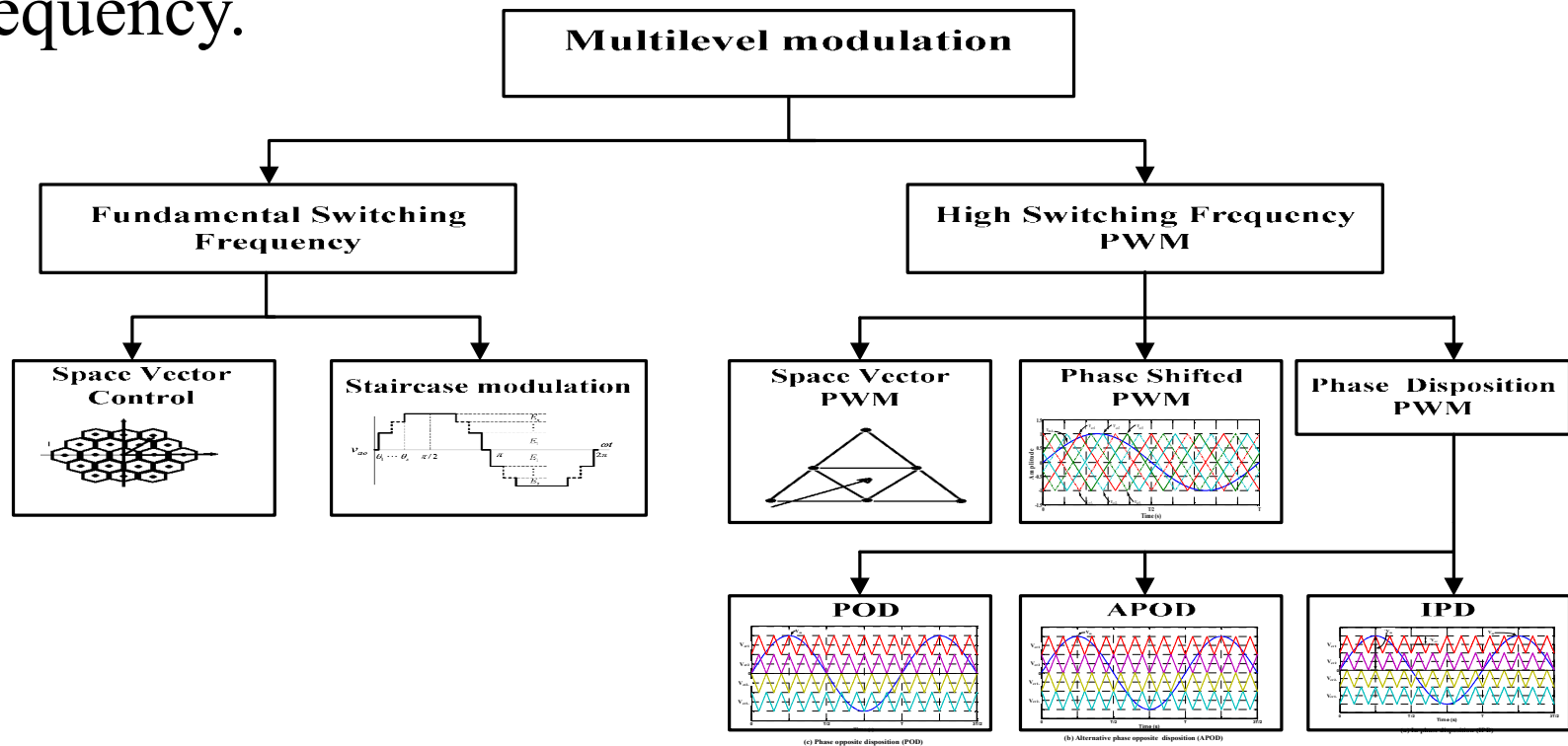


Other types of multilevel inverters

- ❖ Mixed-level multilevel inverter topologies
- ❖ Generalized multilevel inverters (GMLI)
- ❖ Soft-switched multilevel inverters
- ❖ Generalized multilevel current source inverter (GMCSI)

Conventional Modulation Techniques

Today, there are many modulation techniques for multilevel applications and they can be classified in two main groups, depending on their switching frequency.



Multilevel modulation classifications.

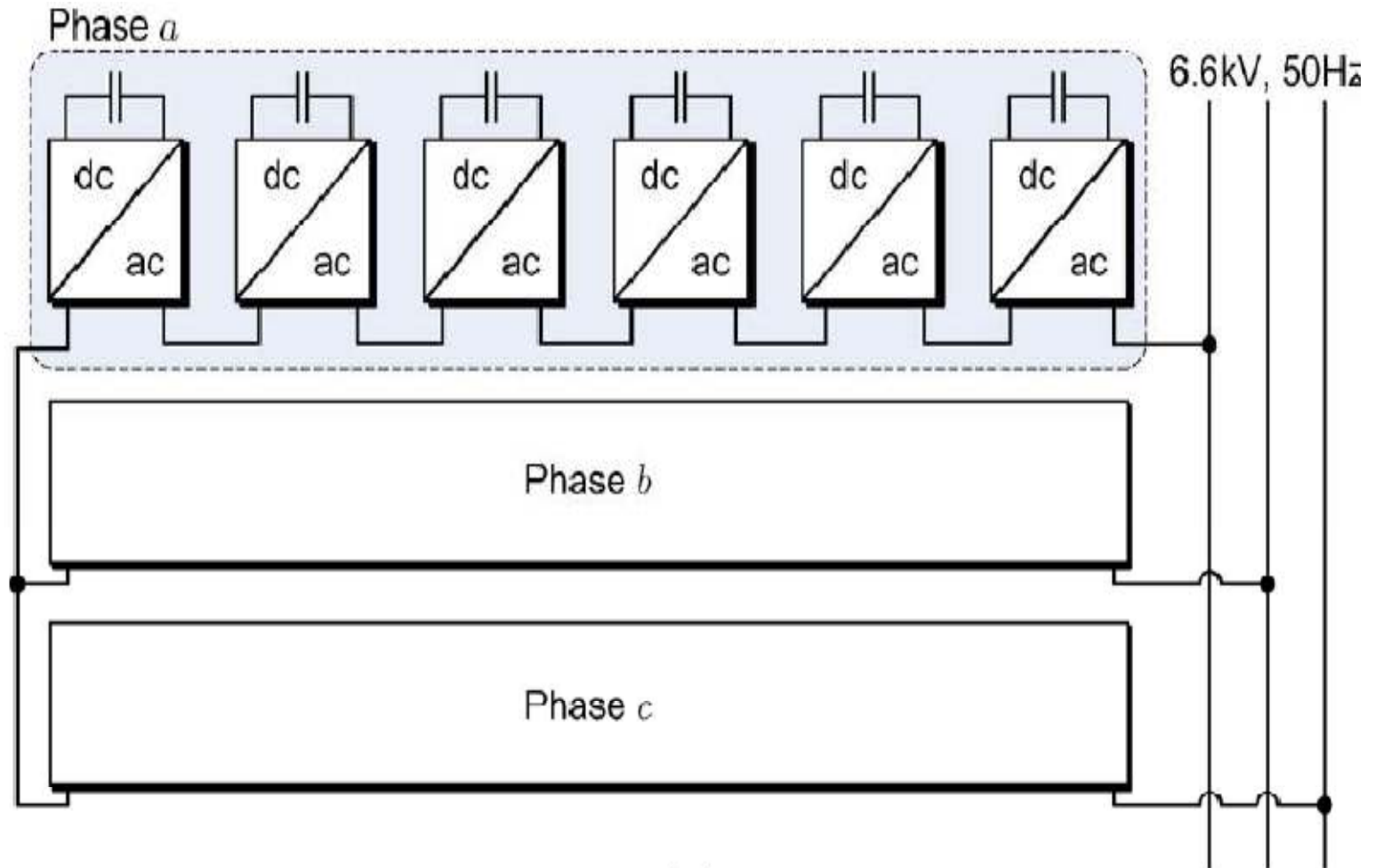


Recent Advances In Multilevel Inverter Applications

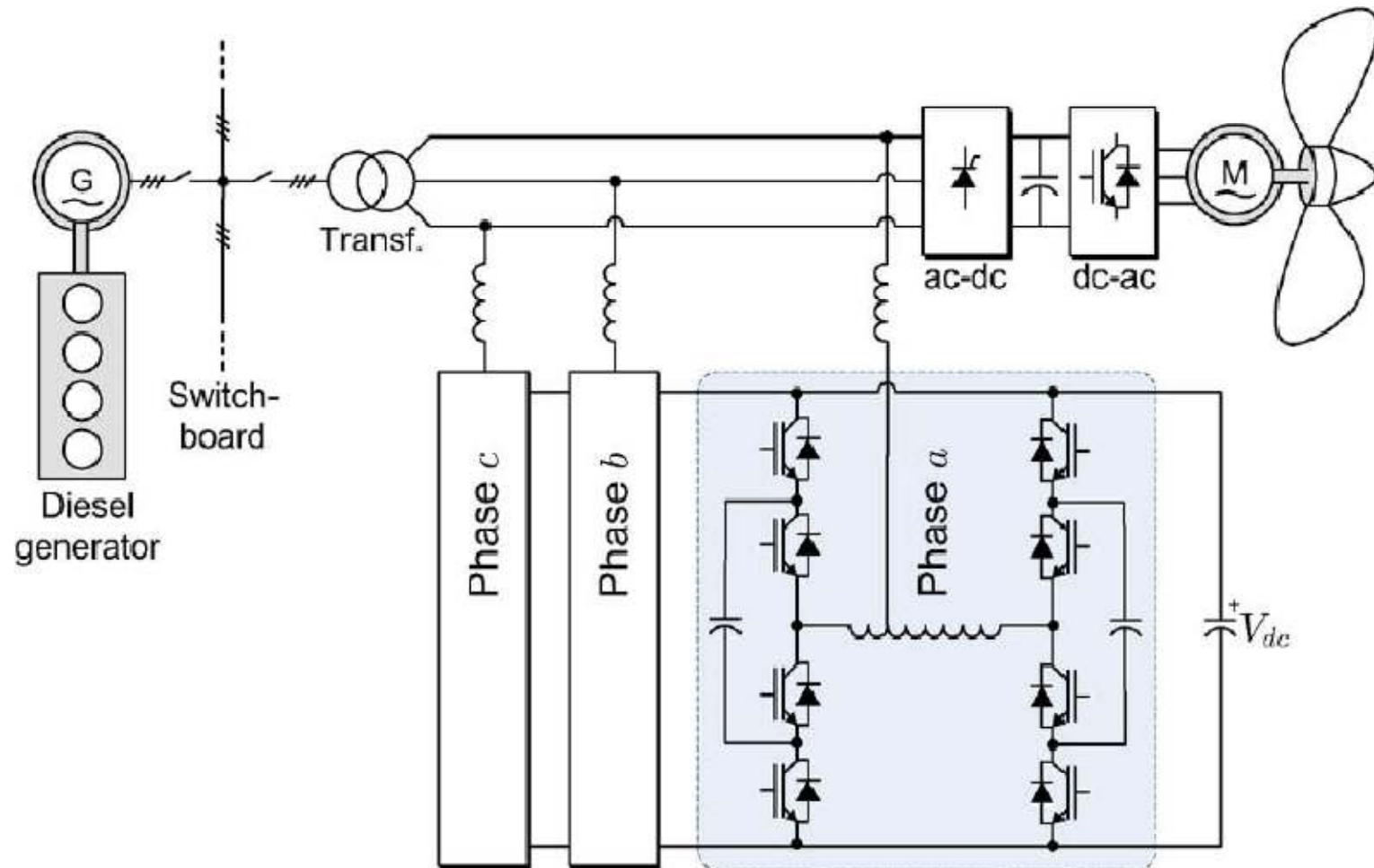
Multilevel voltage source converters have successfully been applied and are an important alternative that competes with PWM-CSI in classic applications:

compressors, pumps, fans, rolling mills, and conveyors, to name a few .It is worth noticing that these processes are the most common medium-voltage applications in the industry today

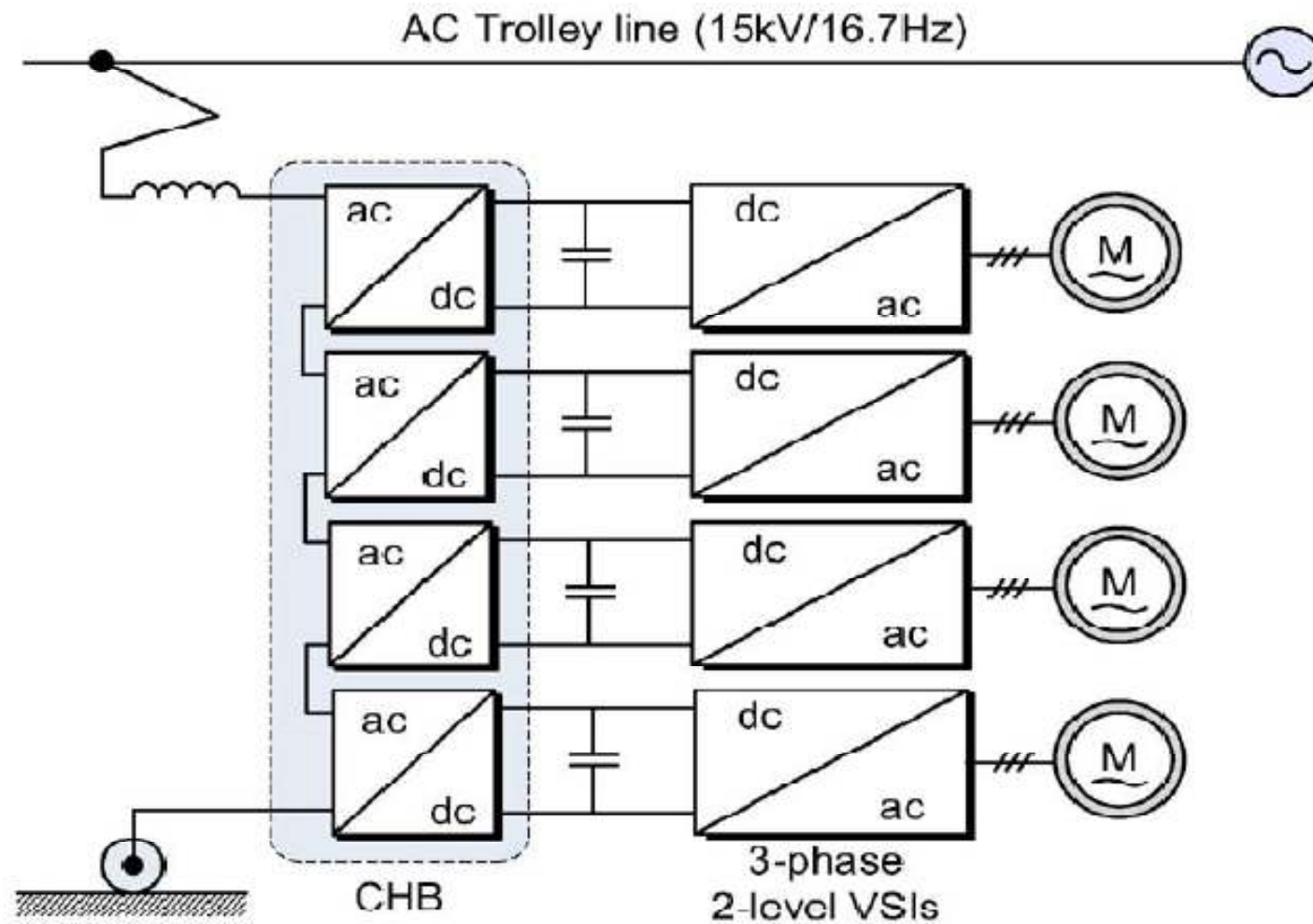
Applications in Power Systems



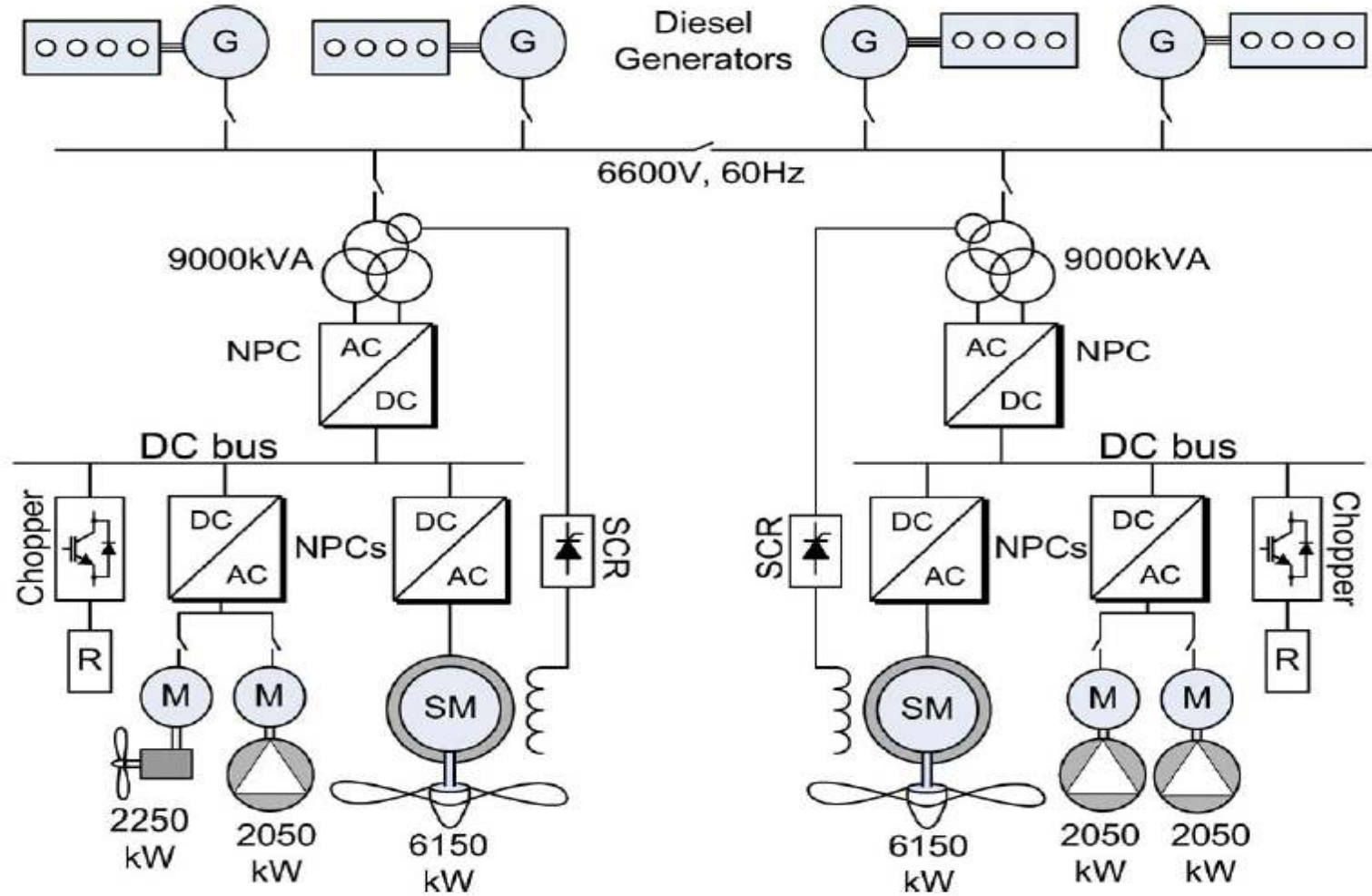
Applications in Power Systems



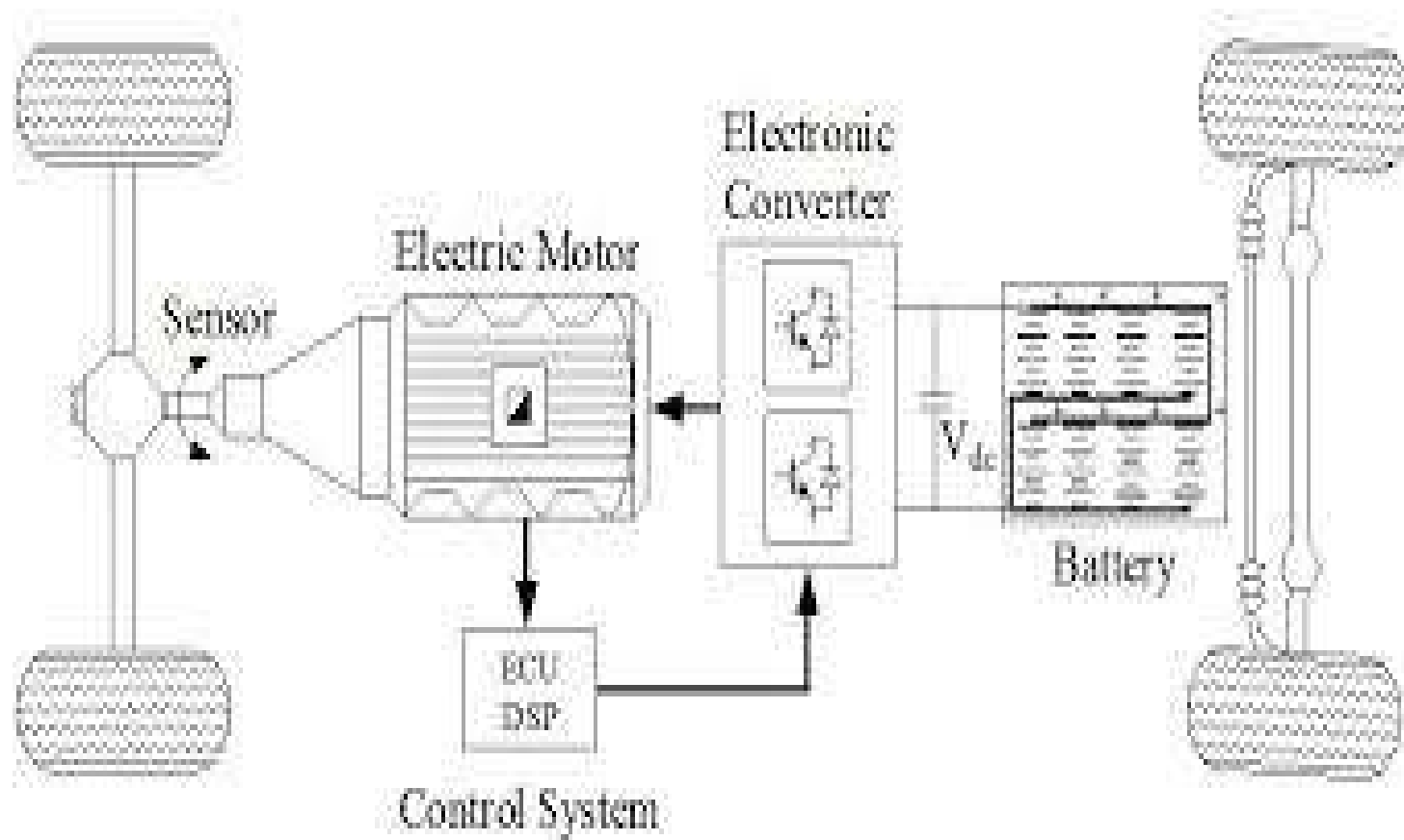
Train Traction



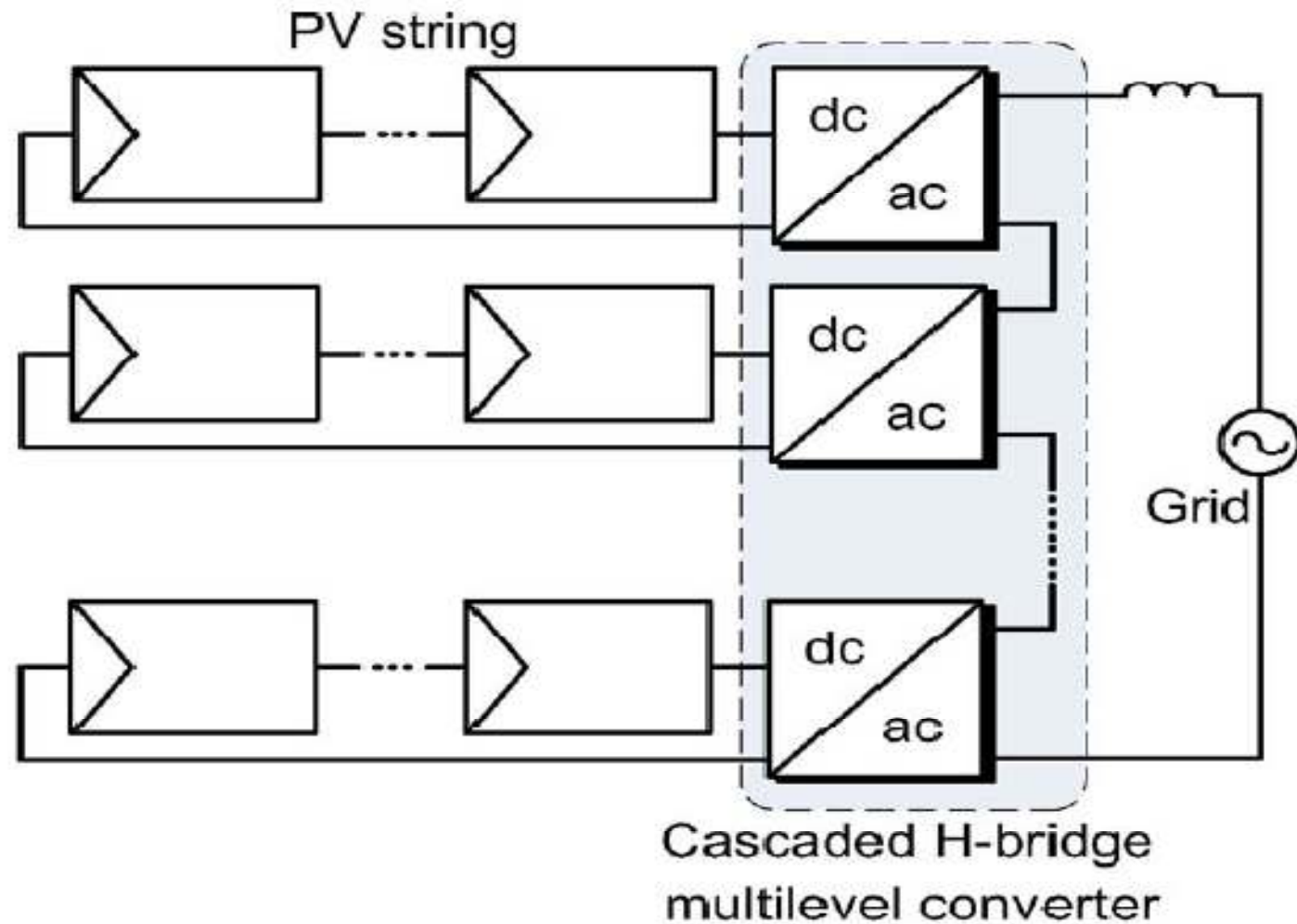
Ship Propulsion



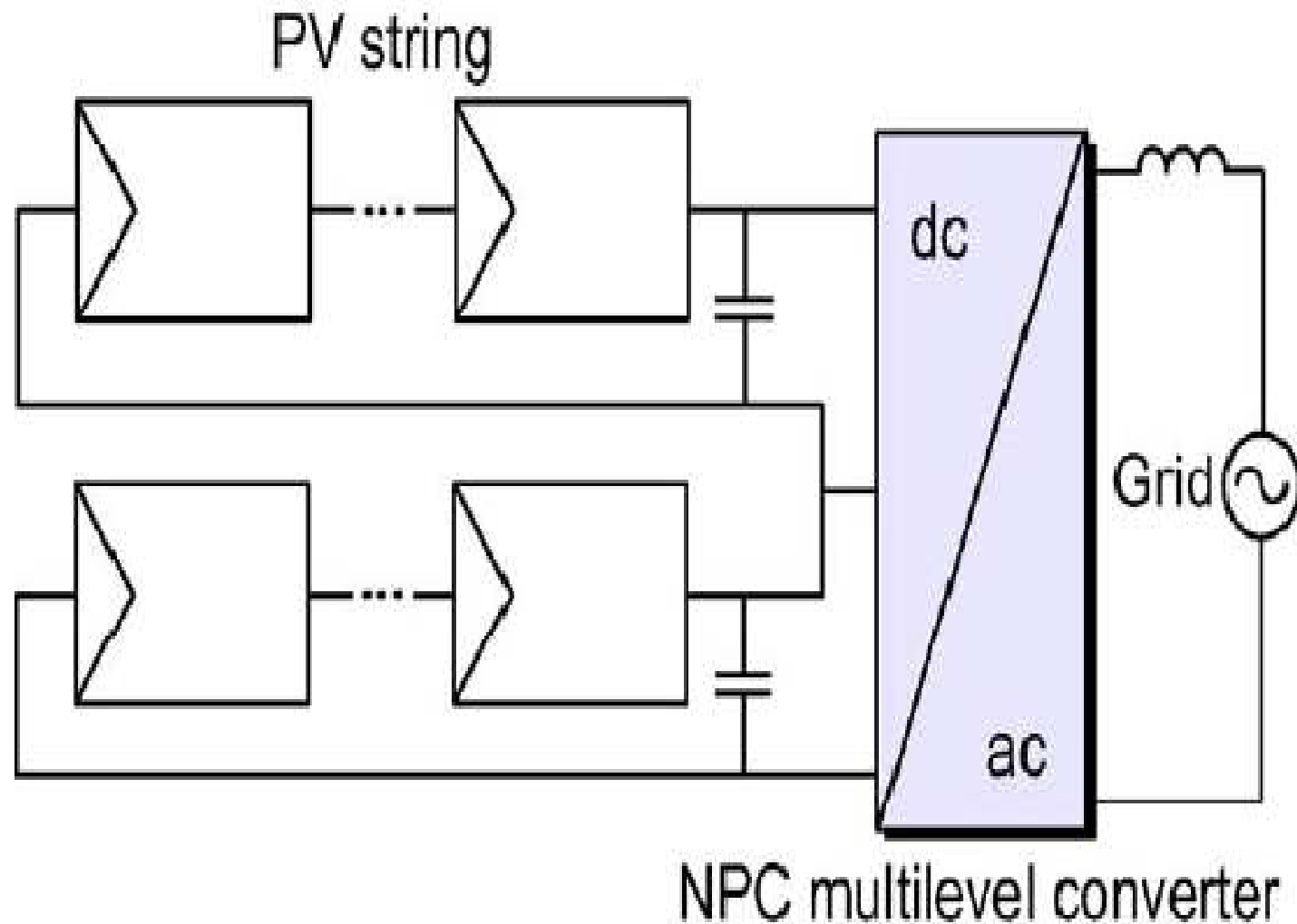
Automotive Applications



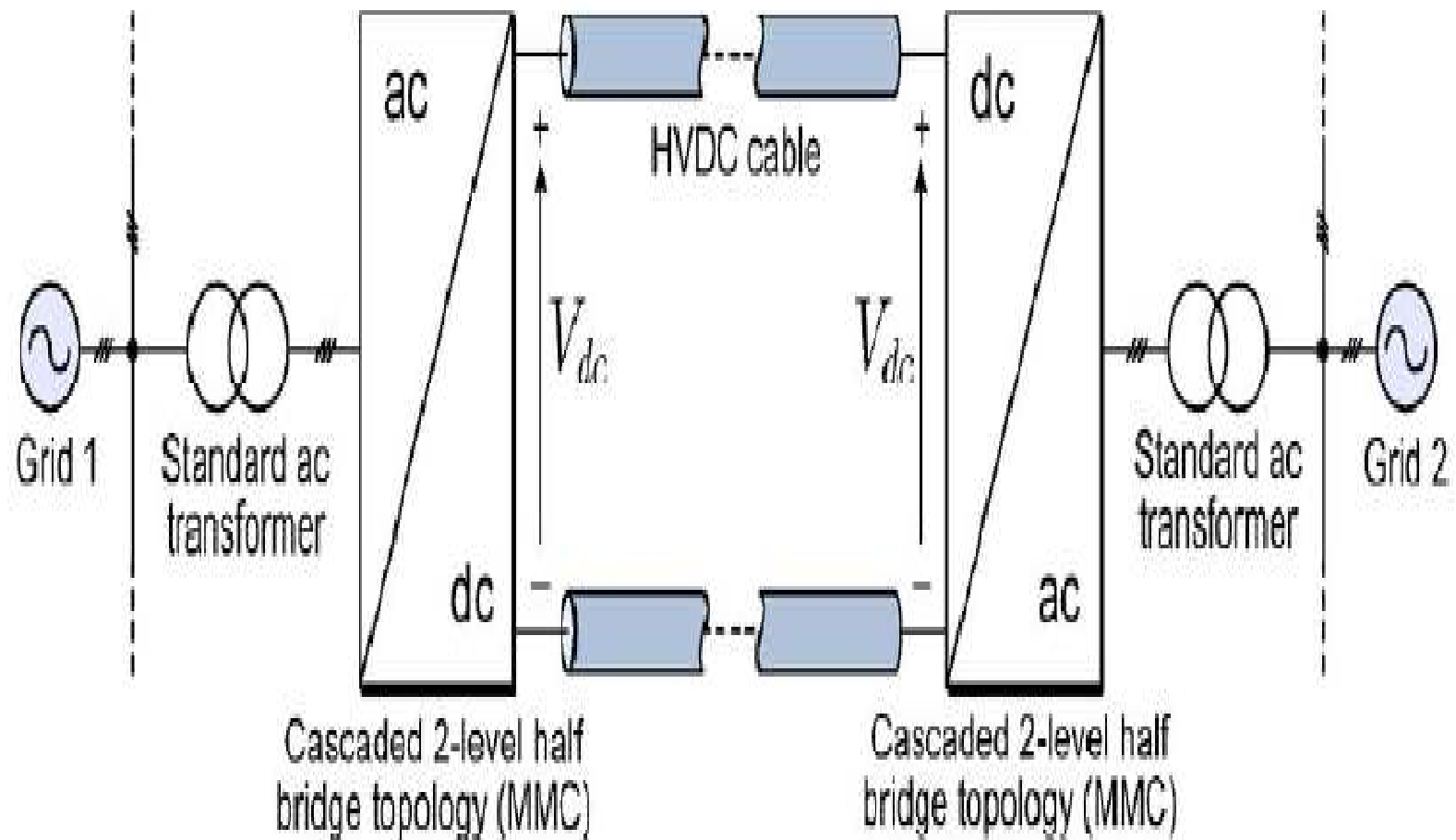
Energy Generation, Conversion, and Transmission



Energy Generation, Conversion, and Transmission



Energy Generation, Conversion, and Transmission





Special Thanks

To

*All of you for your attention
and support*