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A SURVEY OF MULTILEVEL INVERTER TOPOLOGIES FORGRID INTEGRATION OF SOLAR

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ABSTRACT:

Multi-level inverters (MLI) are gaining research interest for utilizing solar energy since they serves two importantpurpose of converting DC output generated into usable AC output and maintains the quality of power services. There are numerous research on-going related to the second aspects of inverters and they are popularly known as multi- functional inverters. In this paper a brief overview of multi-functional grid tied MLI has been briefly overviewed. The comparative analysis of available (MF-MLI) Multi-functional MLI has also been presented.

KEYWORDS: *Multi-level inverters (MLI), Multi-functional MLI (MF-MLI), Neutral Point Coupling (NPC),Cascaded MLI (C-MLI), Pint of Common Coupling (PCC).*

1. INTRODUCTION

Solar systems generally employed as standalone system or grid connected inverters [1]. The standalone system generally supplies the local load like, rooftop system of remotely installed system where grid can't be reached [4, 5].The grid connected system needs a proper synchronization to interact with the grid [2, 3].the profitability of such system is worthy when the communication and power flowis two way. Which means power can either be supplied or can be consumed when needed.The availablegrid interactive PV system can be as shown in Fig.1. Various architecture and control topologies have been proposed in literature on integration of wind and solar energy systems and their hybrid combinations for power quality improvement when operated in a stand-alone as well as grid connectedmode [6]-[8].

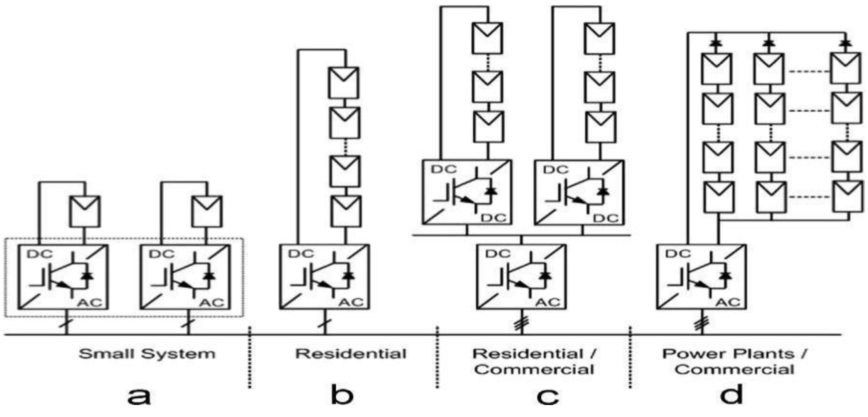

Fig. 1 Typical configuration of the grid interactive PV-system; (a)module inverter,(b) string inverter, (c) multi-string inverter,(d) central inverter.

2. MULTI FUNCTIONAL GRID INTERACTIVE MLI

In medium and high-power range utilizations, MF-MLI with grid technology is a very efficient alternative as the heart of interfacing systems for integration of PV systems into utility grid. The unbeatable harmonic-spectrum, low voltage rating of the power switches, decreased common mode voltages and lesser voltage changes (dv/dt) are important advantages of ML-MFGCIs. However, the complexity of control method rises compared to the traditional two-level inverter. As illustrated in Fig. 2, ML-MFGCIs can be classified based on the power circuit structure to mitigate PQproblems: (1) voltage source ML-MFGCIs and (2)current source ML-MFGCIs.

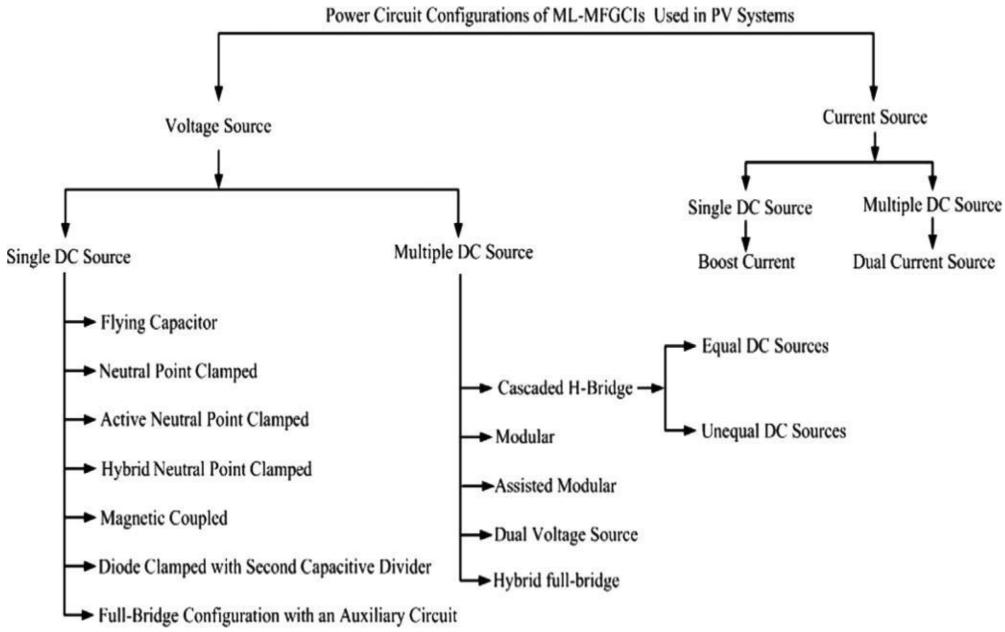

Fig. 2 Classification of MF-MLI.

2.1 Neutral point clamped (NPC-MF-MLI)

The NPC is designed by a series combination of power switches whose connecting point is clamped by the combination of two diodes between consecutive pairs and the neutral point is clamped with the combination of capacitors as shown in fig.3 (a) [13]-[15]. The negative point of the upper inverter and the positive point of the lower one are assembled together to constitute the new phase output, while to make the neutral point N, the initial phase outputs are connected via two clamping diodes. These are efficient in applications operating at fundamental frequency switching [16].

2.2 Flying Capacitor (FC-MF-MLI)

The structural combination of FCMLI is similar to NPCMLI only difference is that the diodes are replaced by capacitors as shown in fig. 3 (b). In this topology the load cannot be directly connected to the neutral, but, the zero level is achieved by connecting the load to the positive or negative side through the flying capacitor with opposite polarity with respectto the DC-link [17].

2.3 Cascaded (C-MF-MLI)

CHB-MFGCIs are composed of the series connection of two or more single phase H-bridge inverters as shown in Fig. 3(c). Each H-bridge inverter corresponds to two voltage source phase legs, where the line to line voltage is the inverter output voltage. Therefore, a single H-bridge inverter can generate three different voltage levels. To avoid DC-link capacitor being short circuits, each leg has two possible switching positions. The zero level can be obtained by connecting the phase outputs to the positive or the negative sides of the inverter. The comparison and functionality based on their classification is presented in table2. Table 1 presents the nomenclature for the table 2.

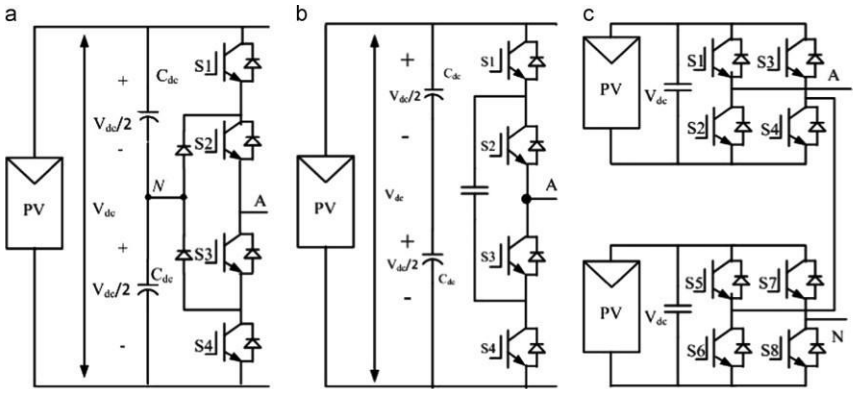

Fig 3. Power circuit configuration of Three-level (a) NPC-MF-MLI, (b) FC-MF-MLII, (c) C-MF-MLII.

Table 1. Abbreviations of MF-MLI configurations.

Abbreviation	Description
VSMF-MLI	Voltage source MF-MLI
CSMF-MLI	Current source MF-MLI
NPC-MF-MLII	Neutral point clamped MF-MLI
ANPC-MF-MLI	Active neutral point clamped MF-MLI
DC-MF-MLI	Diode clamped MF-MLI
FC-MF-MLI	Flying capacitor MF-MLI
CHB-MF-MLI	Cascaded H-bridge MF-MLI
ACHB-MF-MLI	Asymmetric cascaded H-bridge MF-MLI
DVS-MF-MLI	Dual voltage source MF-MLI
PFC	Power factor correction
APF	Active power filter

Functionality	Topology	Levels number	Control method
APF,PFC [13]	C-MF-MLI	7	-
APF,PFC	C-MF-MLI	11	Pq with PI and repetitive controller

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[14]			
APF [15]	C-MF-MLI	7	-
PFC [16]	Full bridge with auxiliary circuit	5	Digital PI current control algorithm
PFC[17]	C-MF-MLI	13	-
PFC [18]	AM-MFGCI	31	pq
PFC [19]	DCMF-MLI	3	
PFC [20]	DCMF-MLI with second capacitive divider	5	Digital PI current control algorithm
PFC [21]	C-MF-MLI	5	PI current control algorithm
PFC [2]2	Full bridge with auxiliary circuit	5	Digital PI current control algorithm
PFC [23]	C-MF-MLI	5	PI and PR current control algorithm
PFC [24]	AC-MF-MLI	19	Average power control
PFC [25]	C-MF-MLI	3	Dual loop current controller
PFC [26]	C-MF-MLI	9	pq based a fully FLC without any PWM and PI controller
PFC [27]	M-MF-MLI	3	Dq current control
APF,PFC [28]	C-MF-MLI	21	pq
APF,PFC [29]	DVS-MF-MLI	3	PI base current control
APF,PFC [30]	NP C-MF-MLI	3	The pq theory (pq0-current control),

3. CONCLUSION

This paper present a brief overview of new type of MLI that is multifunctional MLI topology which serves PQ issues while integrating PV with the utility system. There are numerous research on-going related to the second aspects of inverters and they are popularly known as multi- functional inverters. In this paper a brief overview of multi-functional grid tied MLI has been briefly overviewed. The comparative analysis of available (MF-MLI) Multi-functional MLI has also been presented.

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