Review of the h-bridge three-phase low power dissipation connected micro-grid network

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Abstract. This paper discusses low-power H-bridge filters connected to micro-grid networks. Installation of resistors as damping can improve drop power efficiency and maintain THD under the IEEE standard but creates new problems in terms of resonance when increasing output power. Filter analysis and filter results describe the proposed passive LCL H-bridge damping performance. To ensure the desired power out ability and to ensure the desired dynamic performance, the resistor as damping is determined is tested, while the capacitance is chosen to minimize damping reduction. From the result of our research, with the comparative analysis we get, namely: The smaller the resistance value, the smaller the power and efficiency decrease, but the smaller the loss losses, while the greater the value of resistance the higher the output power and efficiency, but frequency losses also higher. The H-bridge filter has excellent capabilities in reducing harmonics 0.6% and power efficiency 92-95%, proving that the 80ohm resistance value is up to 150ohm. At a value of 200ohm, it only produces losses against frequency.

1. Introduction

The development of power plants is increasing where it is seen that electronic-based power plants are becoming one of the modern power distribution systems, interfacing control interfaces have become a very important problem and flexible and extraordinary opportunities for strong integration of renewable energy-based generating units by addressing various quality problems power[1].

One important tool in a renewable power generation system is a filter[2,3]. Filters are needed in converter systems to improve harmonic attenuation performance. Among the filter designs, the LCL filter[4] attracts more attention because of its much lower weight and size, compared to a single L filter. However, the LCL filter introduces substantial complexity into the controller design because of the phenomenon of resonance. Thus, a damping solution is needed to stabilize the converter system.

The LCL filter has a high order harmonic attenuation capacity and characterizes better dynamics. However, it can cause stability problems due to unwanted resonance[5]. To avoid this phenomenon, we chose a passive damper solution that uses physical resistance that is connected in series-parallel with resistors, inductors, and filter capacitors, the reason for choosing this type of damper is low cost and ease of integration into medium-scale network three-phase grid-connected systems. This filter category is used to connect inverters with grid networks to reduce high-frequency harmonics caused by pulse width modulation and harmonic switching frequencies produced by inverters connected to grid networks. The aim is to achieve the IEEE 519-1992 standard by reducing current harmonics around the
switching frequency and reducing power losses[6]. Therefore, this solution is proposed by providing an H-bridge type filter design that can provide the best especially fundamental characteristics, power efficiency, and output power[7].

The desired achievement in this paper, looking for the truth in the stability of the system is H-bridge[8]. Then the mathematical method is used as an analysis, vector space as a determination[1].

The remaining sections in this paper are organized as follows. Part 2 discusses the basic theoretical system model. Section 3 shows the simulation results. Section 5 presents data analysis. Finally, the work is concluded in Section 6.

2. A grid-connected voltage distribution system model

2.1. Model of the grid-generator system

The design of the power converter uses the Orcad Spice A / D Light 6.9 program[9]. Signal generators and analysis components are modeled in the SPICE program. In this design, we will present the effects of changes in resistor values, which will prove fundamental frequency response conditions, THD, output power, voltage amplitude, and power efficiency. The form of visual design in a circuit scheme with a full-bridge configuration (VSC) connected grid is modeled in figure.1 according to 220V household load.

![Diagram of grid-connected power plants](image)

**Figure 1.** Model of grid-connected power plants

M1, M2, M3, M4, M5, and M6 as switching devices for each Mosfet MOSFET are with the current switch, for diodes D1, D2, D3, D4, D5, and D6, producing VR, VS, VT signals are amplitude from the PPF Voltage and PPF IR output, IS, IT is the amplitude of the PPF current. The signal and triangle boxes are generated from controls E1, E2, E3, E4, E5, and E6 are PWM or SPWM modulation techniques. Modulation method as a control system controller in maintaining the desired frequency In the simulation phase the PWM and SPWM methods are used as output ratios. Where the quality of the output of the converter looks well from the output voltage. Some converter outputs with VR, VS, VT, and IR, IS, methods that are less harmonious are ideal.

2.2. Distribution model to load

Whereas the connected grid uses a wye connected electronic circuit where the input terminals have three and the output terminals there are four connected grid circuit schemes shown in figure 2. The wye circuit is a substitute for the transformer, where the output is 220V. 6, 7, 8 as the inverter input terminal, while 6, 7, 8, 9 are the grid output terminal area.
2.3. *Used load model*

In figure 2, we present four types of load combinations that are used in the household. The three household expenses are resistive load, inductive load, and capacitive load.

![Circuit wye](image1)

**Figure 2.** Circuit wye

2.4. *Soaking topology design model*

In the filter model, use a passive filter. Passive filters are known as harmonic traps and reduction in size and cost. The passive immersion topology option used to limit the resonance conditions of a filter is based on the passive shunt filter reducer that is dedicated to the power system or the most widely applied. This article aims to test the ability of resistor or damper values if the values vary. The equivalent filter circuit must consider several, immersion to take into account the dependence of the parasitic effect of the passive component. Only a little can be found in the current power conversion unit[9].

![Unused load](image2)

**Figure 3.** Unused load

![Filter circuits](image3)

**Figure 4.** Filter circuits
The passive filter solution is intended in Figure 4 is adopted and is very simple, the resistor is installed in parallel with the inductor series capacitors on two different sides. Series resistors along with capacitor functions as channels with slightly large impedances and are effective in harmonic immersion but have very little output power.

The components contained in the design have installed values such as Table. Where the input and output inductors have different install values, because of the conditions encountered too. Immersion inductors have the same value on each phase line, both different positions, flowing currents can be soaked in different directions. While the resistor is connected between the function of the inductor and capacitor as attenuation.

3. Filter involvement and loads on the system

3.1. Frequency response characteristics

Results obtained in figure 5 shows the results of fundamental characteristics, as expected. Where resonance rotation can be reduced, the above fundamental frequencies can be overcome using a 20ohm damper up to 150ohm. While the 200ohm damper affects the new effect of increasing resonance rotation. Which means that the capabilities and disadvantages of the H-bridge type can be obtained.

![Graph](image)

a. 20ohm

![Graph](image)

b. 80ohm
Figure 5. Measurement of the characteristics of the Frequency Response from the Filter

3.2. Time-domain output voltage simulation

Figure shows the output waveform of the output voltage of the H-bridge filter. This proves that the harmonic immersion results in the formation of sine waves have good results. To measure the amplitude of a sine voltage, it is necessary to consider the impedance values in the inverter and filter output terminals.
a. 20ohm

b. 80ohm

c. 100ohm

d. 150ohm
3.3. Time-domain output power simulation

The results of the analysis of active power in the spice program with controlled PWM for output power. As shown in Figure, it seems that the LCL H damper filter provides sufficient power performance both before and after a 2000Watt load.
4. Simulation analysis results

4.1. Total distortiiharmonic
Differential equations in the spice lite program produce an analysis of the THD values shown in table. The results obtained for the average for each damper present a harmonious value below 5%, which means that the value achieved is very satisfying.

Table 1. THD measurement data.

| Damper Value | Stand THD | Phase R THD % | Phase S THD % | Phase T THD % |
|--------------|-----------|---------------|---------------|---------------|
| c            | V         | A             | V             | A             |
| d            | V         | A             | V             | A             |
| e            | V         | A             | V             | A             |

Figure 7. Measuring out power
4.2. Power efficiency

From the results the equation of power efficiency in a spice program with PWM control has an average power loss value of 5%. As shown in Figure, it seems that the damper filter provides sufficient performance both before and after involving the load.
5. Conclusions
This paper discusses low-power H-bridge filters connected to micro-grid networks. Installation of resistors as damping can improve drop power efficiency and maintain THD under the IEEE standard but creates new problems in terms of resonance when increasing output power. Filter analysis and filter results describe the proposed passive LCL H-bridge damping performance.

To ensure the desired power out ability and to ensure the desired dynamic performance, the resistor as damping is determined is tested, while the capacitance is chosen to minimize damping reduction. From the results of our study, with the comparative analysis we get, namely: The smaller the resistance value, the smaller the 2KW out power and the efficiency decreases by 70% but the smaller the frequency losses, while the greater the resistance value the higher the 3KW output power and efficiency 95%, but frequency losses are also higher. The H-bridge filter has excellent capabilities in reducing harmonics and power efficiency, proving that the 80ohm resistance value is up to 150ohm. At a value of 200ohm, it only produces losses against frequency.

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