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MODELING OF SPACE VECTOR MODULATED QUASI-Z-SOURCE MULTILEVEL INVERTER FOR GRID-TIE SINGLE-PHASE PV SYSTEMS

[#1]**B SANTHOSH,** *Associate Professor,*

[#2]**MD KHAJA PASHA,** *Associate Professor,*

Department of Electrical And Electronics Engineering,

TRINITY COLLEGE OF ENGINEERING & TECHNOLOGY, KARIMNAGAR, TS.

ABSTRACT: The installation of a grid-connected solar power system (PV) is the principal aim of this undertaking. To carry this out, a QZS-CMI, or quasi-Z-source cascaded multilevel inverter, will be used. By lowering total harmonic distortion, a quasi-Z-source network, when coupled with a conventional cascaded multilayer inverter, greatly improves a power plant's efficiency and performance. Linking renewable energy sources to streamline transportation. An impedance network is the core component of our standard, one-stage power converter. The system's Z-source inverter is its most important part. It can do buck/boost, inversion, and power conditioning all at once, and it's more dependable than the Z-Source Inverter (ZSI). The QZSI accomplishes the same goals. With the single-phase QZS CMI, space vector modulation (SVM) can be used without any extra gear. If you could finish making voltage patterns that are in the shape of phases, that would be fantastic.

Keywords: Cascade multilevel inverter (CMI), photovoltaic (PV) power system, quasi-Z source inverter, space vector modulation (SVM).

1. INTRODUCTION

Energy sources that are good for the earth are becoming more and more popular. As the need for energy grows, it becomes harder and harder to find traditional, limited energy sources. Because they only use sun energy, photovoltaic (PV) systems are the easiest and most useful renewable energy source out there. A lot of research and development is being done right now on new, low-cost methods and system combinations for making electricity. Cascaded Multilevel Inverter (CMI) technology is the best way to get utility-scale energy rates because it doesn't need a generator, is cheap, and works very well. Getting energy at wholesale prices from a big supplier is therefore the best thing to do.

The current quasi-Z-source converter-modulator-inverter (ZS-CMI) has parts of the regular Z-source inverter (ZSI). In this clever setup, the source and the inverter are linked by an impedance network, which lets the power be switched between sources and amplified. It still has all of the great features of the original ZSI. Both the general reliability and the ability to add or remove power have gotten a lot better. Also, the one-step direction change has been made better. Most buck converters, like voltage source inverters (VSI) and current source inverters (CSI), can only make an output voltage that is higher than the inputting direct current (DC) voltage. When two switches on the same leg or phase are turned on at the same time, a source short can happen.

These problems don't happen with inverters that are set up as Z-source or quasi-Z-source, because these types of inverters have many zero states that can discharge as needed. Because the HBI module can only boost voltage so much, the inverter's KVA rating needs to be increased to get a voltage range of 1:1 for the PV system. The DC-link voltages are all over the place because the voltages of the PV panels are always changing. It is possible that adding more DC-DC boost converters could help the CMI's PV screens reach maximum power point tracking (MPPT).

The power of the DC link might stay stable with this method. Adding more dc-dc converters makes the power circuit and control system work better, makes the system easier to use, and lowers the cost. In solar systems, Z-source and quasi-Z-source cascade multilevel inverters (ZS/QZS-CMI) are used a lot. The goal of this method is to take the best parts of both traditional CMI topologies and Z-source topologies and put them together. There is no need for grid harmonic output filters when there is low harmonic distortion and good staircase output voltage waves. It is possible to save a lot of money by using power semiconductors with lower values.

Each inverter has the same modulation, control design, and circuit construction because they are built with a modular architecture. This is what happens because the system is made up of modules. What controls the voltage across the DC link is the electronics in the system. Individuals can keep full and steady control over the energy flow with this function.

When the dc-link voltage and pulse width modulation (PWM) voltage are changed independently, the ZS/QZS-CMI works better. The main goal of this project is to find out if ZS/QZS networks are possible and what the best conditions are for building them. The goal of this study is to find ways to find the control grid input and QZS module's maximum power point tracking.

2. BLOCK DIAGRAM

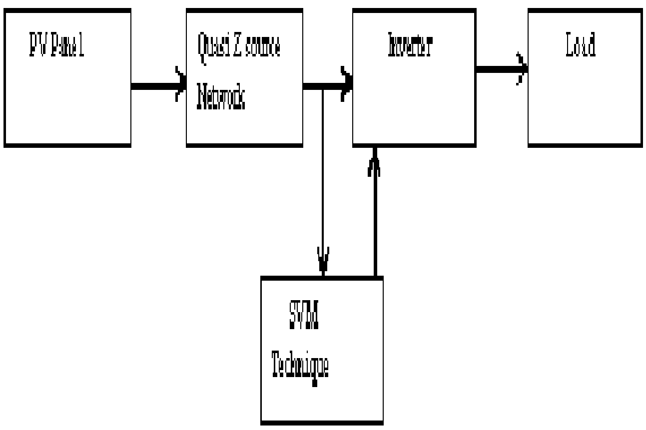

Fig. 1.Block Diagram

Figure 1 shows the general style of the book. PN circuits turn light into power in photovoltaic cells. Easily and quickly, solar energy can be turned into electricity Light that is absorbed by a semiconductor releases electrons, which are then called free electrons. Depending on the material used, photovoltaic (PV) technology usually makes a minimum voltage of 0.5 V to 0.8 V. Photovoltaic modules are made up of many cells that are linked together in both parallel and series to make enough electricity to power a device.

An equation for a solar array is solved to get the I-V and P-V graphs. You can get a good idea of how much sunlight a photovoltaic panel receives by looking at how much power it produces at its peak. As the first step in the process, a dc/dc converter could be used because it can send power at carefully controlled duty cycles. A method that keeps an eye on the spot with the highest strength can help find the change signal. To find the most important point, the Perturb and Observe (P&O) method is used. This method doesn't change the system very much.

This problem is most likely going to cause a power surge that lasts for a long time. A disturbance happens as it moves clockwise from its source when power is lost. This process is kept up until the amount of stability that is needed is reached. The PI controller will change the PV module's operating point to make sure it is linked to the voltage that makes the most energy. There are different kinds of power sources that the quasi-Z stacked network can use. The DC voltage in the network is then changed to AC power by a transformer.

Depending on the changing input voltage, the gadget can work in one of two ways. Shoot-through and non-shoot-through are two different types of shooting. When both switches can be closed at the same time, QZSIs, which are also called cascaded quasi Z source inverters, lower the voltage. This mode is turned on when the system is not under a lot of stress and the input voltage is higher than the average input voltage. Because it can run all or two of its switches in fire-through mode, the QZSI is perfect for situations where switching needs to happen at the same time. VSI shorts out the circuit, so it can't be used in this mode. Because it wasn't made to work with VSI, this mode doesn't work with it.

3. CIRCUIT DIAGRAM

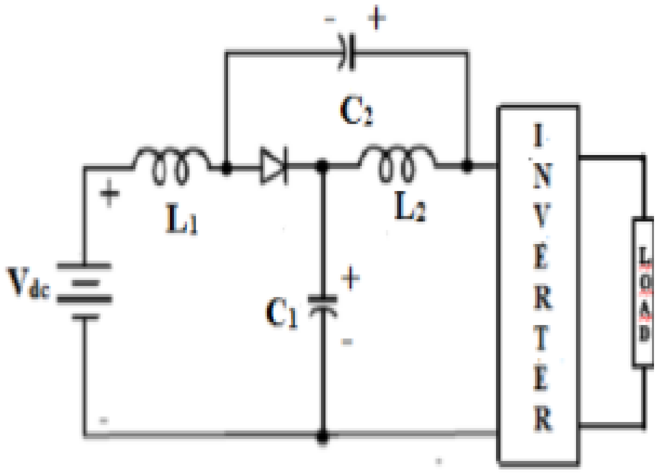

Fig. 2. QZSI Diagrammatic Representation

In Figure 2, you can see the voltage that is put on the QZSI device. The connection between the QZSI and ZSI changes when the inverter bridge is linked to an LC and diode network. This makes the shoot-through condition possible. Because of the (quasi-) Z-source network, the voltage across the DC link goes up during the shoot-through. On the other hand, this network protects the link.

The QZSI's shoot-through mode stops the capacitor from short-circuiting and lets the dc side inductors (L1 and L2) hold on to more magnetic energy. With this kind of magnetic storage device, when the motor is running, the voltage at the output of the inverter goes up. If the input voltage goes over a certain level, the inverter can work as a standard voltage source inverter (VSI). This makes sure that the output voltage of the inverter stays the same. The devices for releasing waste are no longer working.

The Zero Sequence Inverter (ZSI) has a much lower voltage across capacitor C2 and irregular current usage compared to the quasi-ZSI. The QZSI, on the other hand, takes the alternating current from the source and turns it into a steady direct current. Because it doesn't depend on the voltage of the control parts as much, building C2 is easier than building C1.

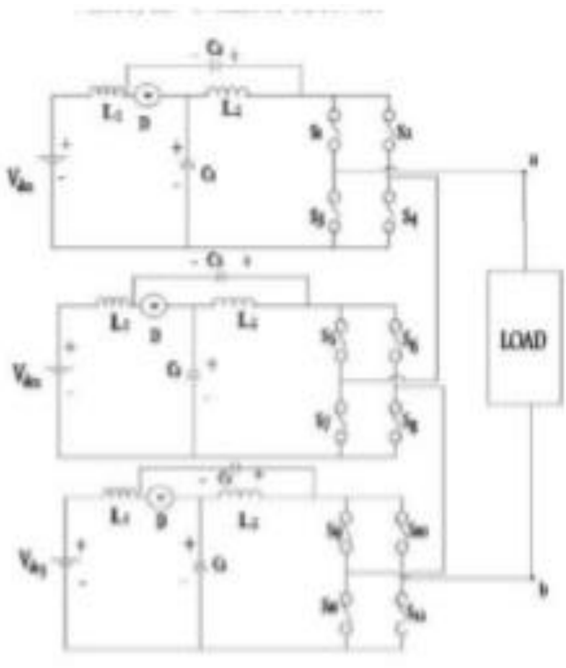

Fig. 3. Shows a QZSI cascaded inverter that is set up with a single phase and seven levels.

Figure 3 uses a quasi-Z source to show how the design of a single-phase cascaded inverter is put together. There are seven floors in all. The DC sources are linked to two split inductors, L1 and L2. The coming switches are linked to two capacitors, C1 and C2. In the shoot-through mode, Diode D protects the circuit and lets the (quasi-) Z-source network raise the voltage across the DC link.

Because a standard Z-source inverter and a QZSI have different impedance designs, they must also be built in different ways. When set up with its AC outputs, a quasi-Z-based seven-level cascaded inverter needs to switch between the seven voltage levels. The following cases give more information about this idea: There are also voltage choices for +Vdc and +2Vdc, with a range of -3Vdc to +Vdc. Table 1 shows detailed information about each of the seven parts that make up the transformation plan as a whole. For the QZS-HBI family, shoot-through states are very important. At the transition places, the lower switches' switching times will either come before or after the upper switches'.

The shoot-through steps are spread out evenly across the QZS-HBI module, so there is no need for extra switching, allocating resources, or data loss. A twisted alternating current (AC) voltage pattern is made by the phase difference between two voltage vectors that come one after the other. This shows how many times a reference voltage vector has been turned on and off. There are many reference vectors that make up the voltage vector for QZSI HBI units.

4. CONCLUSION

Table.1. modifying the approach to take

S_1	S_2	S_3	S_4	S_5	S_6	S_1'	S_2'	S_3'	S_4'	S_5'	S_6'	V_{ab}
1	0	0	1	1	0	0	1	1	0	0	1	$+3V_{dc}$
1	0	0	1	1	0	0	1	1	0	1	0	$+2V_{dc}$
1	0	0	1	0	1	0	1	1	0	1	0	$+1V_{dc}$
1	0	1	0	0	1	0	1	1	0	1	0	0
0	1	1	0	0	1	1	0	1	0	0	1	$-1V_{dc}$
0	1	1	0	0	1	1	0	0	1	0	1	$-2V_{dc}$
0	1	1	0	0	1	1	0	0	1	1	0	$-3V_{dc}$

MODULATION TECHNIQUE

If you want to make a multi-layered alternating current (AC) voltage from different direct current (DC) inputs, you have to turn semiconductor devices on and off in a way that reduces harmonic distortions and increases the generation of the needed fundamental frequency. Changing the times that the gadgets are turned on and off is one way to fix the problem. There are a lot of different switching methods that can be used with multilayer inverters. This is the cascade QZSI that is often found with PWM using carrier-based and space vector methods: When a zero-sequence voltage is used as an input, the space vector modulation (SVM) method works better than the carrier-based pulse width modulation (PWM) technique at controlling harmonics.

When it comes to general switching trends and limits, SVM is easier to handle. The SVM method is also useful because it is simple to use. Support Vector Machine (SVM) is used to control inverters in this work, which makes it better than others that have been done before. Using both virtual and real data, we test how well modulation and support vector machine (SVM)-generated suggestions for circuit functions work.

A standard single-phase converter and the SVM method can be used to figure out the SVM of each QZS-HBI. It is possible to do this because the QZS network is built into the HBI core. The carrier frequency is stored by the first QZS-HBI module, which uses the other two vectors to make the reference voltage vector. Time is based on how strong the zero voltage zone and active normal vectors are. Time moves in a way that is also affected by the length of the dynamic vectors. Because of this study, we show how to use a quasi-Z source in a Support Vector Machine (SVM)-based cascaded multilevel inverter. For a quasi-Z-source stacked inverter, SVM is used to make switching signals. With the help of space vector modulation, MATLAB/Simulink can copy a quasi-z-source or a seven-level inverter.

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