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A Modified Ac-Dc Converter Based On Dual Buck-Boost for DC Nano Grid

Perapogu Ashwini [1], MD. Faizullah [2]
[1]P.G. Scholar, [2]Assistant Professor
[1,2] Branch Peed-Power Electrical & Electronic Drives
[1,2] Department : EEE
[1,2] Dr.K.V.Subba Reddy Institute Of Technology
Emaill: [1]ashwinip11093@gmail.Com, [2]cherry.faizulla@outlook.com

ABSTRACT

Because of the broadly utilized DC described burdens and progressively disseminated power age sources, the DC Nano-network turns out to be increasingly prevalent and it is viewed as an option in contrast to the AC-framework. For security contemplations, the DC Nano-network ought to give solid establishing to the private burdens like the low voltage AC control framework. There are three run of the mill establishing designs for a DC Nano-matrix, including the unified establishing, the unidirectional establishing and the virtual disengaged establishing. Each establishing setup has its very own details to AC/DC converters. In this letter, a double Buck-Boost AC/DC converter for use in the unified establishing arrangement based DC Nano-framework with three terminal yields is proposed. The working guideline of this converter is exhibited in subtleties through dissecting the comparable circuits. Tests are completed to confirm the hypothetical examination.

Index Terms—DC Nano-grid, Grounding, AC/DC Converter, Buck-Boost.

INTRODUCTION

Each Electronic circuit is accepted to work some supply voltage which is normally assumedto be steady in nature. A voltage controller is a power electronic circuit that keeps up a consistent yield voltage regardless of progress in load current or line voltage. Various sorts of voltage controllers with an assortment of control plans are utilized. With the expansion in circuit unpredictability and enhanced innovation a progressively extreme necessity for exact and quick direction is wanted. This has prompted requirement for more up to date and increasingly solid structure of dc-dc converters. The dc-dc converter inputs an unregulated dc voltage info and yields a steady or controlled voltage. The controllers can be for the most part grouped into direct and exchanging controllers. All controllers have a power exchange arrange and a control hardware to detect the yield voltage and modify the power exchange stage to keep up the consistent yield voltage. Since a criticism circle is important to look after control, some sort of pay is required to keep up circle dependability. Remuneration procedures shift for various control plans and a little flag investigation of framework is important to structure a steady pay circuit. State space investigation is regularly used to build up a little flag model of a converter and after that relying upon the kind of control conspire utilized, the little flag model of converter is adjusted to encourage the plan of the remuneration arrange. As opposed to a state space approach, PWM switch demonstrating builds up a little flag of exchanging parts of converter.

Social displaying of the IC framework speaks to the usefulness of an IC with full scale models instead of real execution of the circuit utilizing progressively effective mod eling systems. ORCAD is integral asset to create social models of electronic framework. Recreation offers the benefit of its graphical UI and square chart usage of any framework. It additionally underpins composing capacity and incorporation of C program code. The examination attempted in this proposition builds up a framework level plan approach for exchanging voltage controllers of the three noteworthy control plans. The essential converter topologies and their waveforms are looked into. In Particular, a little flag show alongside the different exchange elements of a buck converter are inferred utilizing state space technique. An exceptionally basic and simple system to touch base at the PWM model and pay for two kinds of control plans: in particular voltage control, current control plot is talked about. Framework level models are executed utilizing the in ORCAD. The accompanying examination gives subtleties of systems to planning every segment or squares essentially the BUCK converter utilized in the exchanging controller. At long last, viable outcome and reenactment results are displayed for voltage and current plans and determined the best possible structure to motivate anticipated that qualities would run the guitar processor.

BACKGROUND STUDY:

Social demonstrating is a quick, effective and simple way to set up a given hypothesis and all the more significantly the most proficient way to build up an immediate correlation between contending techniques. The voltage control plot is the reason for further developed control plans. An arcadeimplementation of voltage controlled buck converter is introduced. Voltage control has an ease back transient reaction because of the transfer speed restriction of the mistake speaker in the input way. The DC-DC converter is intrinsically a high swell framework and to misuse this Feature current mode control was broadly utilized for better transient reaction to line variety. Anyway this methodology relies upon blunder enhancer speed to control stack variety. In this proposition all examination are for steady recurrence control or pulse width modulation .

DC-DC CONVERTER:

DC – DC converters are control electronic circuits that convert a dc voltage to an alternate voltage level. There are distinctive sorts of transformation strategy, for example, electronic, straight, exchanged mode, attractive, capacitive. The circuits portrayed in this report are named exchanged mode DC-DC converters. These are electronic gadgets that are utilized at whatever point change of DC electrical power starting with one voltage level then onto the next is required. Conventionally the utilization of a switch or switches with the end goal of intensity change can be viewed as a SMPS. From now onwards at whatever point we notice DC-DC converters we will deliver them regarding SMPS. A couple of utilizations of enthusiasm of DC-DC converters are the place 5V DC on a PC motherboard must be ventured down to 3V, 2V or less for one of the most recent CPU chips; where 1.5V from a solitary cell must be ventured up to 5V or more, to work electronic hardware. In these applications, we need to change the DC vitality starting with one voltage level then onto the next, while squandering as meager as conceivable all the while. At the end of the day, we need to play out the change with the most noteworthy conceivable effectiveness. DC-

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DC Converters are required in light of the fact that not at all like AC, DC can't just be ventured up or down utilizing a transformer. From multiple points of view, a DC-DC converter is what could be compared to a transformer. They basically simply change the information vitality into an alternate impedance level. So whatever the yield voltage level, the yield control all originates from the contribution; there is no vitality made inside the converter. An incredible opposite, in truth some is unavoidably spent by the converter hardware and parts, in carrying out their responsibility.

TYPICAL GROUNDING CONFIGURATIONS FOR RESIDENTIAL DC NANO-GRID APPLICATIONS

3.1 INTRODUCTION:

In order to ensure the safety in the grid, most of household appliances are required to be connected with ground line, so in a DC Nano-grid, like in a low voltage AC grid, ground line should be provide. There are three basic grounding configurations, which include the united grounding, the unidirectional grounding and the virtual isolated grounding. They will be explained in the following

The distributed power generation is becoming more and more attractive due to the long term lack of energy andthe environmental problems caused by the fossil energy. A large number of distributed generation systems, like photovoltaic systems, are today connected into the AC power system, where they can cause problems like voltage rise and also issue related to protection .Further, more and more loads show DC characteristics, for example, LED lightings, computer power supplies, and also variable-frequency techniques based household electrical appliances. The DC Nano-grid may be a good solution to solve the voltage rise and protection problem of the conventional AC power system and can dismiss the traditional AC/DC converters for DC characterized loads, which may result in reduced power losses and material savings.

Recently, research on DC Nano-grid gets of more and more concern, especially for the control of AC/DC topologies, which are the connections between the DC Nano-grid and the traditional AC power system. It should be pointed out, when designing the AC/DC converters for DC Nano-grids, the grounding configuration needs to be addressed, since it determines the costs, the flexibility of the installation and also the efficiency of DC Nano-grid system.

This letter analyzes first three grounding configurations of the DC Nano-grid. Then, a dual Buck-Boost AC/DC converter is proposed, which will facilitate the applications of the DC Nano-grid with three terminal outputs. Also, theoretical analysis of the proposed converter will be given as well as experimental verifications are carried out. Finally, conclusions are drawn.

UNITED GROUNDING CONFIGURATION:

In this configuration, the AC low power system and the DC Nano-grid use the same ground line. Fig. 1 shows a typical AC/DC converter connection.

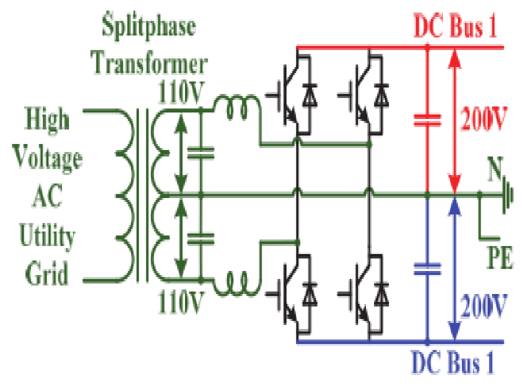

Fig. 1. Typical AC/DC converter for the united grounding configuration based DC micro grid system.

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Fig 17: Typical AC/DC Converter for United grounding configuration

The advantage of the united grounding configuration is that the DC Nano-grid can easily be installed into the original low voltage AC power grid to form a hybrid power system. The disadvantage is that due to the low voltage devices, most of the original low voltage AC power systems cannot adopt this configuration and share the same ground line directly with a DC Nano-grid, if no special or complicated AC/DC converters are adopted. At the same time, the DC Nano-grid has to adopt a bipolar voltage structure with three terminal outputs.

UNIDIRECTIONAL GROUNDING CONFIGURATION:

As described above, due to the low voltage limit of the devices, it is difficult for the DC Nano-grid to use the same ground line of the low voltage AC power system. Many papers are considering the unidirectional grounding configuration to construct a DC Nano-grid.Fig.2 shows a unidirectional grounding configuration based DC Nano-grid with double DC bus and the grounding. In this configuration, the DC Nano-grid absorbs the power from the high voltage AC utility grid through a step down transformer, which works like an isolated transformer.

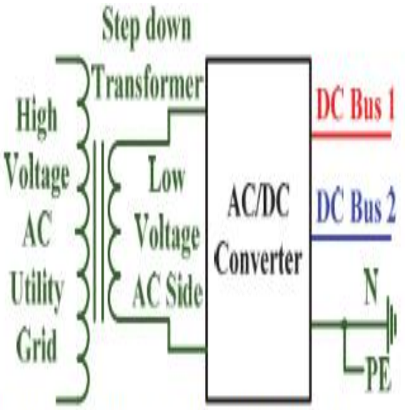

Fig. 2. Unidirectional grounding structure of DC Nano-grid.

Fig 18: Unidirectional grounding structure of DC Nano grid

Since the step down transformer offers a suitable low voltage for the DC Nano-grid, this AC voltage is generally lower than the standard AC voltage. For example, a three-phase step down transformer may output a 200 V phase to phase voltage rather than the standardized 380 V voltage. The AC/DC converter transfers the AC power into the DC power as the required DC voltage output and power rating. For example, the DC Nano-grid can be a single DC bus based system or a double DC bus system.

The advantage of the unidirectional grounding configuration is that the AC/DC converter can use simple structure-converters like the two-level three-phase converter or the three-level three-phase converter or even other.The disadvantage of this configuration is that the output of the step down transformer cannot be connected with other low voltage AC residential loads directly.

VIRTUAL ISOLATED GROUNDING CONFIGURATION:

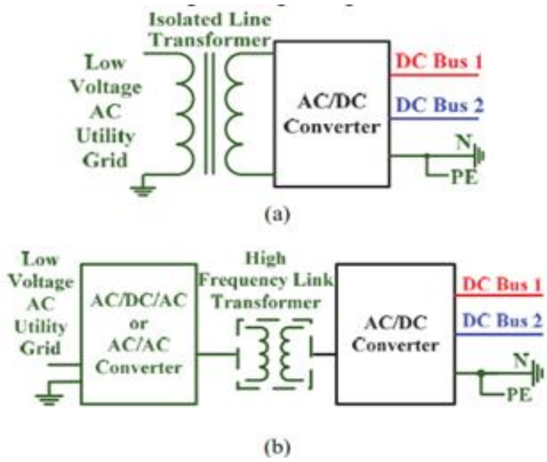

Fig 19: Virtual isolated grounding structure a)Using Line frequency Transformer b)Using High frequency Transformer

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As mentioned in Part A and Part B, it is no easy to realize the hybrid AC and DC grid system with the same ground line due to the reason of the low voltage devices. So the virtual isolated grounding configuration was proposed which has two basic methods as shown in Fig. 3 with different type of transformers.

Fig. 3(a) shows the virtual isolated grounding configuration using line transformer. This method is similar to the unidirectional grounding configuration, while the transformer is connected with the low voltage AC power system instead of the high voltage AC power system. Fig. 3(b) shows the virtual isolated grounding configuration using high frequency link transformer.

Different from the method shown in Fig.3 (a), the high frequency link transformer is used and two converters are adopted to transfer the energy. Due to an improved efficiency of the converter, the high frequency link transformer based method will be more attractive than the line frequency transformer system. The advantage of the virtual isolated grounding configuration is that it is very flexible to construct the DC Nano-grid as required. The disadvantage of the virtual isolated grounding configuration lies in the extra power losses brought by the additional transformer together with the possible more converters to be used. In theory, compared with the AC micro-grid, the DC Nano-grid can save more material and become more efficient due to the fact that less energy conversions are needed. However, as analyzed above, currently, if the DC Nano-grid is connected with the AC power system using the virtual isolated grounding configuration, the efficiency of the system will be reduced, while if using the unidirectional grounding configuration, the flexibility of the DC Nano-grid will be limited. So it is necessary to develop a new type high efficient and low cost AC/DC converter for the united grounding configuration based DC Nano-grid.

PROPOSED AC/DC CONVERTER FOR THE UNITED GROUNDING CONFIGURATION BASED DC NANO-GRID

Traditionally, the DC Nano-grid is connected into the AC power system with bi-directional AC-DC converters, which allows extra DC power to be injected back into the AC power system. In some areas, due to the high population density, the distributed power can generally not meet the demand of the local loads, so the connection between the AC power system and the DC Nano-grid can be simplified to be a power factor correction circuit. In AC/DC converters were reviewed and compared. However, suitable AC/DC converters for the united grounding configuration based DC Nano-grid application were not introduced. In this paper, a new AC/DC converter is proposed.

BASIC TOPOLOGY:

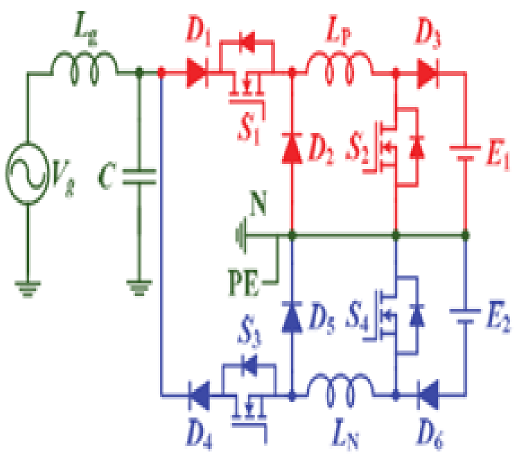

Fig 20: Proposed AC/DC converter for united grounding based Nano Grid

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Fig. 4 shows the proposed AC/DC converter as the connecting converter between three-level voltage DC Nano-grid and the low voltage AC power system. The proposed converter has vertical symmetry structure. During the positive period of the AC voltage, the devices in red work while the devices in black are off. During the negative period of the AC voltage, the devices in black work while the devices in red are off.

When the proposed AC/DC converter is adopted, it will be very convenient to connect the DC Nano-grid into most types of current low voltage AC power system, for example, the single-phase 220 V AC power grid, the 110 V AC power grid, and three-phase four-line 380 V AC power grid using three of the same converters. The DC voltage can also be varied in a wide range.

OPERATING MODES OF PROPOSED AC/DC CONVERTERS:

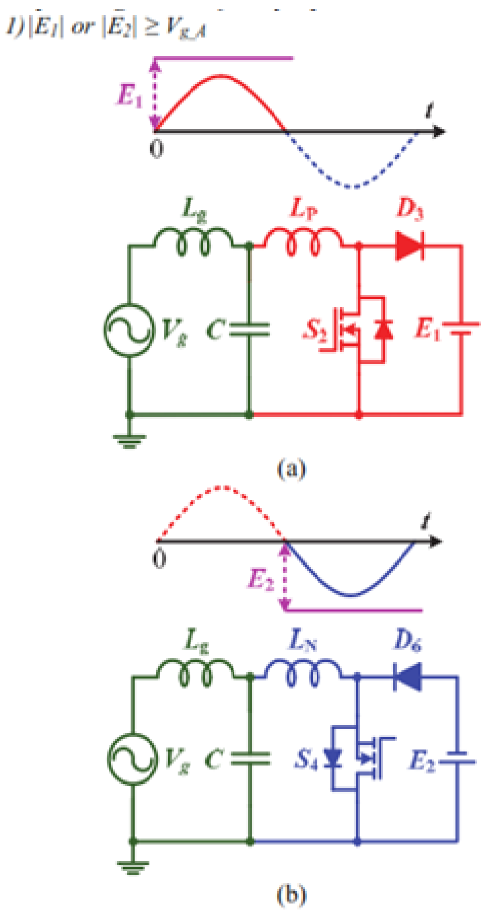

Fig 21: Equivalent circuits when E1 and E2 are higher than the amplitude of grid voltage and operating in boost mode (a)During the positive period (b)During the negative period

Fig 21: Working sequence when E1 and E2 are lower than the amplitude of the grid voltage

2.|E1| and |E2| Vg_a

When the input DC voltages (E1, E2) are lower than theamplitude of grid voltage (Vg_A), the control becomes a littlebit more complicated. Fig. 6 shows the working sequence of the proposed AC/DC converter, when the amplitude of the input DC voltage is lower than the AC grid voltage, and the sequence can be separated into six parts during a full line frequency period.

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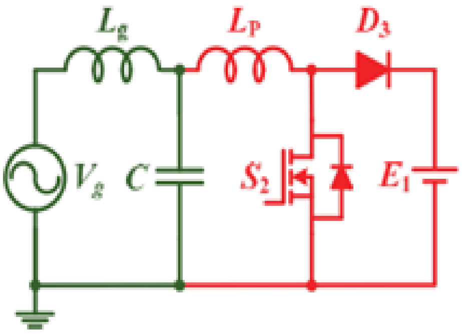
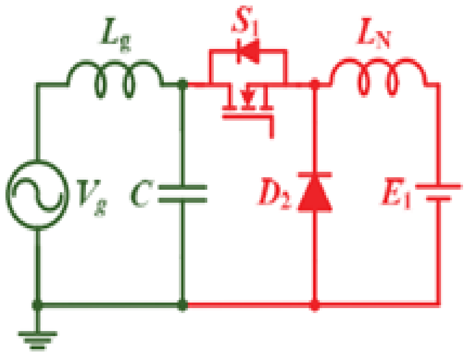
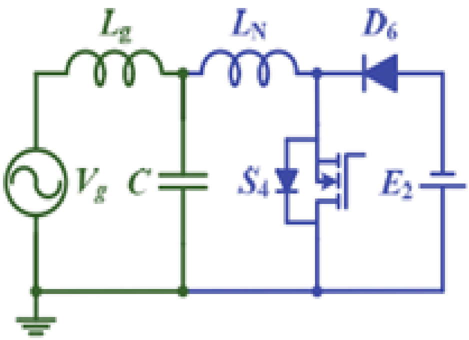


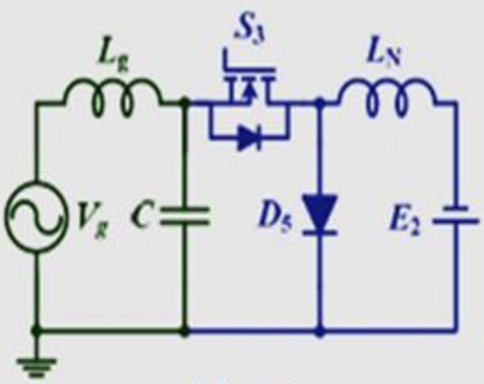
(a) During T_1 and T_3



(b) During T_2



(c) During T_4 and T_6



(d) During T_5

Fig. 22 shows the equivalent circuits in the Buck-Boost operation as shown in Fig 21(a) during T1 and T3 (b)during T2 (c)During T4 and T6 (d)During T5

It can be seen than during the different working sequences, it works as a pure Boost or as a pure Buck converter.

4.3 EXPERIMENTAL VERIFICATION:

Experiments on the proposed AC/DC converter are carried out under the AC grid condition of 110 V/ 50 Hz. The parameters of the prototype are listed in Table I.

TABLE I

DESIGN PARAMETERS OF A 1 KW AC/DC CONVERTER

Para.	L_g	C	L_P, L_N	f_s	E_1, E_2
Units	200 µH	2 µF	400 µH	60 kHz	90V

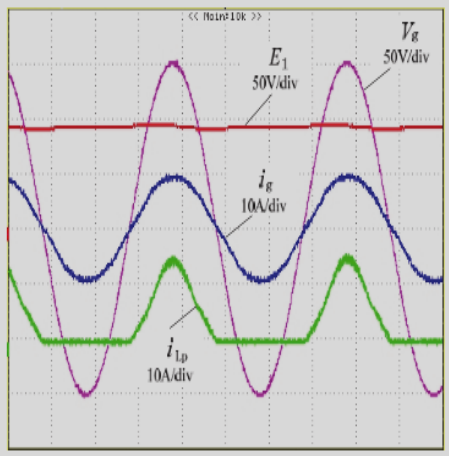


Fig. 8. Measured output DC positive voltage E_1, input AC voltage V_g, inductor current of L_p, and input grid current of i_g.

Fig 23:shows the input AC grid voltage Vg, output positive DC voltage E1, the input AC grid current iLg, and the inductor current of LN. The experimental results meet the theoretical analysis well.

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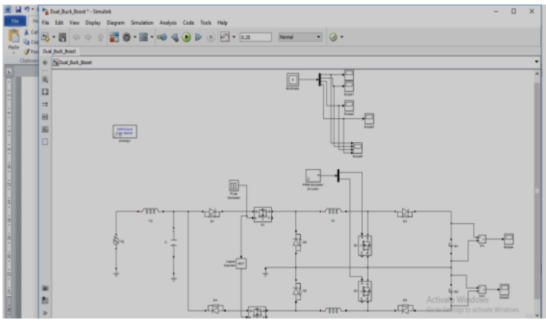

Fig 24: Simulation diagram of Dual Buck Boost Converter

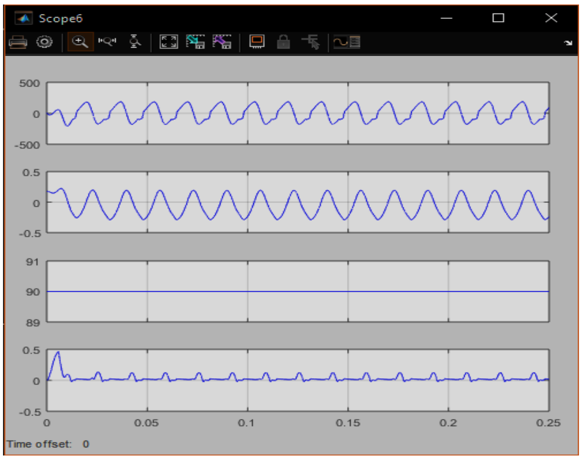

Fig 25: Waveforms of Voltage(Lg), Current(ILg), Battery Voltage (E1), Output Current (Lp)

The simulation outline appeared in figure 9 is executed in the Matlab Simulink programming which demonstrates the double buck support converter where the mosfet is utilized as the switch and the diode with antiparallel impedance is utilized in the circuit. The switches are given the beats from the PWM generator. The yield stack here is the battery and the yield is seen here.

In figure 10 the waveforms which are gotten in the Matlab Simulink are indicated where Vlg is the AC input voltage andLg is the inductor current and E1 is the yield positive DC Voltage and Lp is the yield current.

CONCLUSION AND FUTURE SCOPE

5.1 CONCLUSION:

In private applications, the DC Nano-grid ought to give ground line to security. The establishing setup decides the diverse prerequisites on the AC/DC converters.

In this letter, three sorts of the establishing designs for the DC Nano-grid are abridged. It very well may be concluded,

1. The unified establishing design is the most alluring since the DC Nano-grid can be straightforwardly associated with the low AC control framework utilizing a similar ground line, which will unequivocally address the high proficiency character of the DC Nano-grid. This establishing design makes it simple to develop a DC Nano-grid dependent on the first low voltage AC control framework and adds to the use of the DC Nano-grid. Be that as it may, appropriate AC/DC converters are right now missing of this establishing design.

2.The unidirectional establishing arrangement is generally presented in current DC Nano-grids. It is reasonable for development another DC Nano-grid alone.

3. Contrasted and the unified and unidirectional establishing setups, the adaptability of the virtual segregated establishing design is great, however it results in diminished effectiveness ,more materials, and along these lines greater expenses. In light of the investigation on the establishing, a double

Buck-Boost AC/DC converter is proposed for the assembled establishing setup based DC Nano-grid. The standard of the proposed converter is delineated utilizing proportionate circuits. Examinations are in great concurrence with the hypothetical investigation. The proposed AC/DC converter will abuse the utilization of the DC Nano-grid with three terminal yields.

FUTURE SCOPE:
This work can be additionally stretched out for continuous equipment that is the FPGA arrangement having worked in processor. This will help for getting progressively precise outcomes.

Further the H-Bridge changes can be made in the circuit structure for better execution. The extent of Inductor and Capacitance can be lessened further.

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