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Arduino-Based Three-Phase Direct Current to Alternating Current Inverter for Industrial Use

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Abstract

In this article, we will acquire knowledge regarding the inverter circuit using Arduino as the microcontroller. A DC input from a 12V battery is converted into a 3 phase AC output by this device. According to the findings of our investigation, there are still regions in which the transmission of electricity is not yet feasible due to the high cost that is associated with the transmission of electrical energy. And because there are many locations that do not have access to a three-phase power supply, we have made a decision to develop an inverter that can function using a 12 volt DC battery. Alternatively, it can be powered by the input from a solar panel if it is installed in a location that does not have access to a three-phase power supply or in a location where transmission is not possible. The output AC supply can be utilised for a variety of purposes, including serving as a standby supply or in the event of an emergency. The waveforms that are produced by our hardware have a change in electrical phase of 120 degrees for each unique waveform that is produced. We obtain a three-phase supply on the output side as a result of the utilisation of BJTs and MOSFETs, both of which are arranged in a push-pull configuration.

Keywords: *Inverter, AC supply, Arduino, 3phase transformer, BJT, MOSFET*

INTRODUCTION

Inverters are an essential component of the project since they convert DC electricity to AC power at the frequency and output that the user specifies. The project itself is a hybrid since we are constructing it so that it can run both on batteries and on solar power as the future is moving towards renewable resources and will always deliver three phase supply at the output. This is because the future is going to be focused on renewable resources.

For example, in the agricultural sector, where electricity is hard to come by and, due to the high cost of transmission, cannot be afforded in such places, we can install this circuit. Additionally, in such areas where there are three-phase loads but three-phase supply is difficult to come by in such places, we can use an inverter circuit. The circuit is made up of resistors and an Arduino, which is an open-source electronic software and hardware device. Arduino is a very helpful gadget that is also simple to use and straightforward to programme. Resistors are also included in the circuit.

[6] The electrical phase difference in the waveform that was formed is 120 degrees. MOSFETs and BJTs are utilised so that the input signal may be amplified and converted from a low input signal to a high output signal at the conclusion of the process. These circuits produce a three-phase output at the end with the assistance of three single-phase transformers. Additionally, the output contains some harmonics prior to entering the transformer; consequently, the power devices are connected in such a way as to either reduce or eliminate the harmonics that are present at the output in order to produce a pure sinewave at the output. [13] Therefore, the circuit has potential applications in a variety of settings, including residential, commercial, agricultural, and industrial. [1,2]

COMPONENTS

1. Arduino UNO
2. 12V DC Battery
3. Arduino programming software
4. MOSFET
5. Resistance 6.9V/220V Transformer

ADVANTAGES OF OUR PROJECT

1. Can be used by installing solar panel near the industry.
2. Can be kept as a backup 3-phase supply.
3. Can be used in areas where 3-phase AC is not available.
4. Can be used where power transmission is not possible and hence thereafter

reduces line losses which would comewhile transmitting power.

APPLICATIONS

1. Residential Application
2. Industrial Application
3. Speed control of AC Drives (IM)
4. Electrical vehicles
5. Water pumping

APPROXIMATEPOWERRATING AND COSTING

- Approximate cost: Rs 8000-10000
- Power rating: 1000W(approx.)
- Output from Inverter: 440V AC
- Output from Single Transformer: 230V

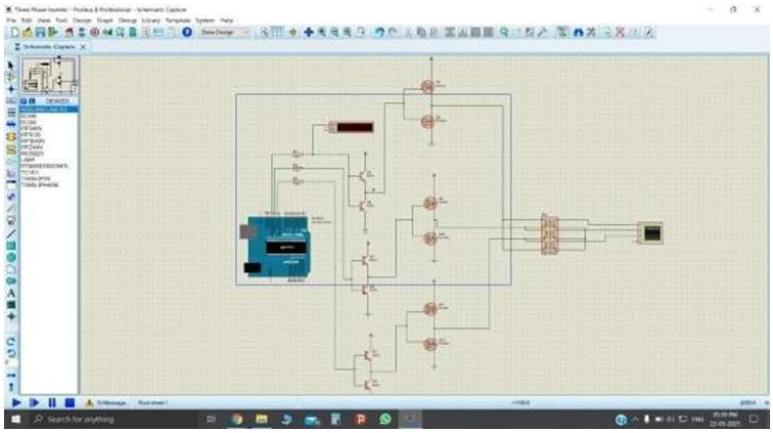
MANUFACTURERS AND SERVICE PROVIDERS

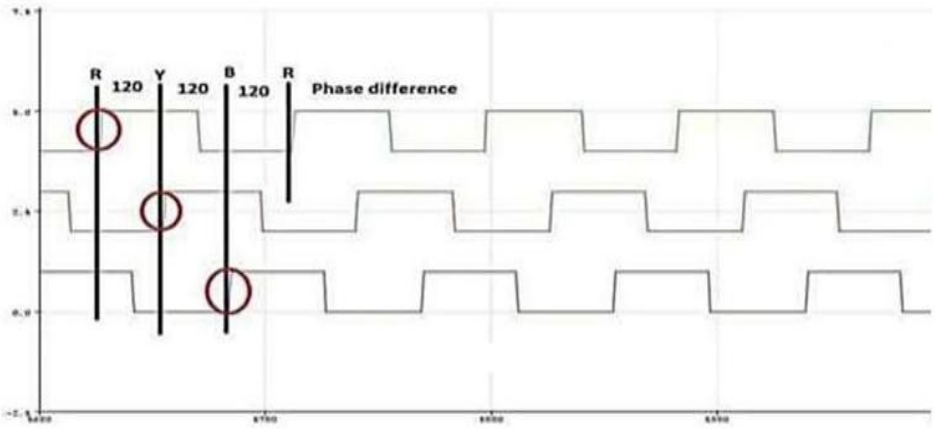
Ranking	Producer
#1	Luminous
#2	Sukam
#3	Microtek
#4	Delta
#5	SMA
#6	Enphase
#7	SolarEdge

METHODOLOGY

In the circuit, all power devices such as MOSFET and BJT are configured in push-pull, those stages are utilized by three individual phases. For further conduction in the circuit Arduino is boosted by BJT.BJT in the circuit boost up the low-level input signal into high level output signal. The transformer is step up which steps the voltage at starting for high tension transmission at primary delta and at secondary star connection is set up, so those 3 single phase transformer may form a single three phase transformer at the output which will 440V at end , in this way a three phase load will be supplied.[3-5]

MODELING AND ANALYSIS





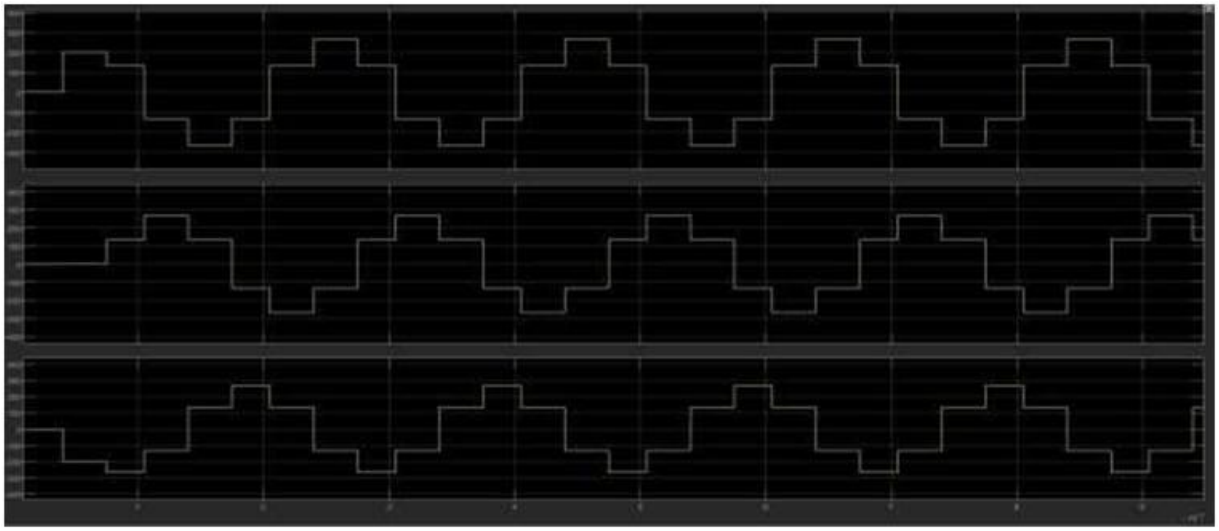
In order for the Arduino UNO board to function and generate signals for the inverter components like BJTs and MOSFETs, it may be powered by either a 12V DC source or a USB power cable, as seen in the figure that is located above this one. There are three resistors with ratings of 4.7k ohms each, and each one is attached to pins 9, 10, and 11 in turn. In order to generate a three-phase shift, the two semiconductors have been arranged in a push-pull arrangement. This project makes use of both six BJTs (model numbers BC-557 and BC-548) and six MOSFETs (model number IRF9540). The inverter converts the incoming direct current source to a three-phase alternating current supply. [7-10] Each phase is linked to one of three separate 12V/220V converters that operate on a single phase. [12] The line-to-line voltage of the AC supply may be increased all the way to 440 volts with the help of these components. The transformers are linked together using a design known as delta-star. The voltage that is output from the line to the neutral is 220V. [11]

The square waveform is the output of our project, and each phase waveform has a phase angle of 120 degrees. We are able to recognise our signal in the wave shape depicted below.

RESULTS AND DISCUSSION

By applying 12 volts DC to the input side of the transformer, we are able to obtain a three-phase supply at the secondary side of the transformer, which is found to be 440 volts Alternating AC voltage. The neutral point is derived by using a delta star transformer, which allows for both single-phase and the three-phase load to be supplied. After the successful operation of our project, we will be able to obtain this supply.

OUTPUT WAVEFORM



OUTPUT READING

Sr No	Type of Supply	Voltage
1	Single phase	220 v Ac
2	Three phase	440 v Ac

CONCLUSION

In conclusion, we can say that Arduino-based inverters are distinct from traditional inverters due to Arduino's user-friendliness, especially for those just starting out. We need a 12V dc supply, which we can acquire either from a battery or by transforming the energy from the sun into electrical energy and then using it. Because this will be a hybrid inverter, we will refer to it as such. One may maintain it as a backup supply in the event that there is a power interruption, as well as utilise it to share the load in the industry by putting it close to the industry, and it can power a variety of loads.

FUTURE SCOPE

As a developing nation, the cost of transmission is extremely high; however, with a circuit, transmission will be simple, and the cost of transmission will be reduced. This will allow it to be used in areas where there is either a lack of or no electricity available at this time; these are areas in which we can use solar energy, which will also be a step toward green energy.

Standby three phase is already available in the system, and it is also very helpful for lighting load; however, transmission of power is not required in this Therefore, there are some fundamental principles, or future scope, that we have kept in mind when building the module, and we believe that this will be of use to people in the future.

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