# Designing Home Inverter Using Cascaded Current Fed Push Pull Converter and SPWM Inverter

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***Abstract:*** *In order to eliminate the low frequency transformer in inverter, cascaded current fed push pull converter with voltage doubler circuit is used, which directly gives step-up DC voltage to the inverter input. This transformer has the drawback of providing low direct input voltage and it is large in size, heavy weight and high cost.*

*By using inverter it increases the efficiency and gives the maximum output voltage In this project, Inductive motor appliances is driven by inverter which is used in residential purposes (AC fan, light). The control mechanism used in inverter is Sine-Pulse Width Modulation (SPWM). The push pull converter stage provides electrical isolation between battery and inverter output. The boosted DC voltage is inverted by SPWM. Microcontroller is used to control the gate pulses of switches in converter.*

***Keywords:*** *Current fed push pull converter, DC/AC inverter, Sine pulse width modulation (SPWM), Microcontroller.*

## I. Introduction

DC to AC inverters are widely used in UPS. In this type of inverters low frequency transformer is used as output for step up voltage. This transformer has the drawback of providing low direct input voltage and it is of large in size, heavy weight and high cost. For the design of high frequency converters step up stage is usually the critical point in battery sourced inverter due to the operation with high input current and high output voltage.

The battery voltage is normally boosted before inverting by cascading step up DC-DC converter stages. Either first or last stage of the converter is isolated by providing galvanic isolation between battery terminals and AC line. The switches in first stage and the last stage will face maximum current stress and maximum voltage stress respectively. The drawback with this system is efficiency which will be the product of efficiency of individual stages.

The current fed push pull converter is used because of its good efficiency. It is used in photo voltaic (PV) application [1] where a soft switching technique is planned for current fed push pull converter in micro grid applications. In solar home applications [2] MPPT tracking algorithm is used for the control. The technique of parallel operation of UPS is been proposed in [3] for maximum power. Super capacitor is used along with the battery to reduce stress [4]. Transformer less UPS with single phase 3wire system is been proposed in [5] and also supports critical loads during utility power failure.

In this paper a current fed push pull converter with voltage doubler secondary is implemented, which directly gives step up DC voltage to the inverter input.It minimizes the need of very high step up ratio transformer. Several cascaded stages of dc-dc conversion is overcome by this converter. This also provides electrical isolation between battery and inverter output. The boosted DC voltage is inverted by SPWM.Microcontroller is used to control the gate pulses of switches in converter.

## II. Description

The inverter has two stages, first is current fed push pull stage, which has a voltage doubler circuit at its secondary side. The input is taken from 12V battery to this stage and output will be 400V DC. The second stage is single phase inverter where this 400V DC is converted to 230V AC. The control mechanism used is sine pulse width modulation (SPWM). The output is filtered by using LC filter. The simulation work carried out is shown.The circuit diagram of this system is shown in fig.1.
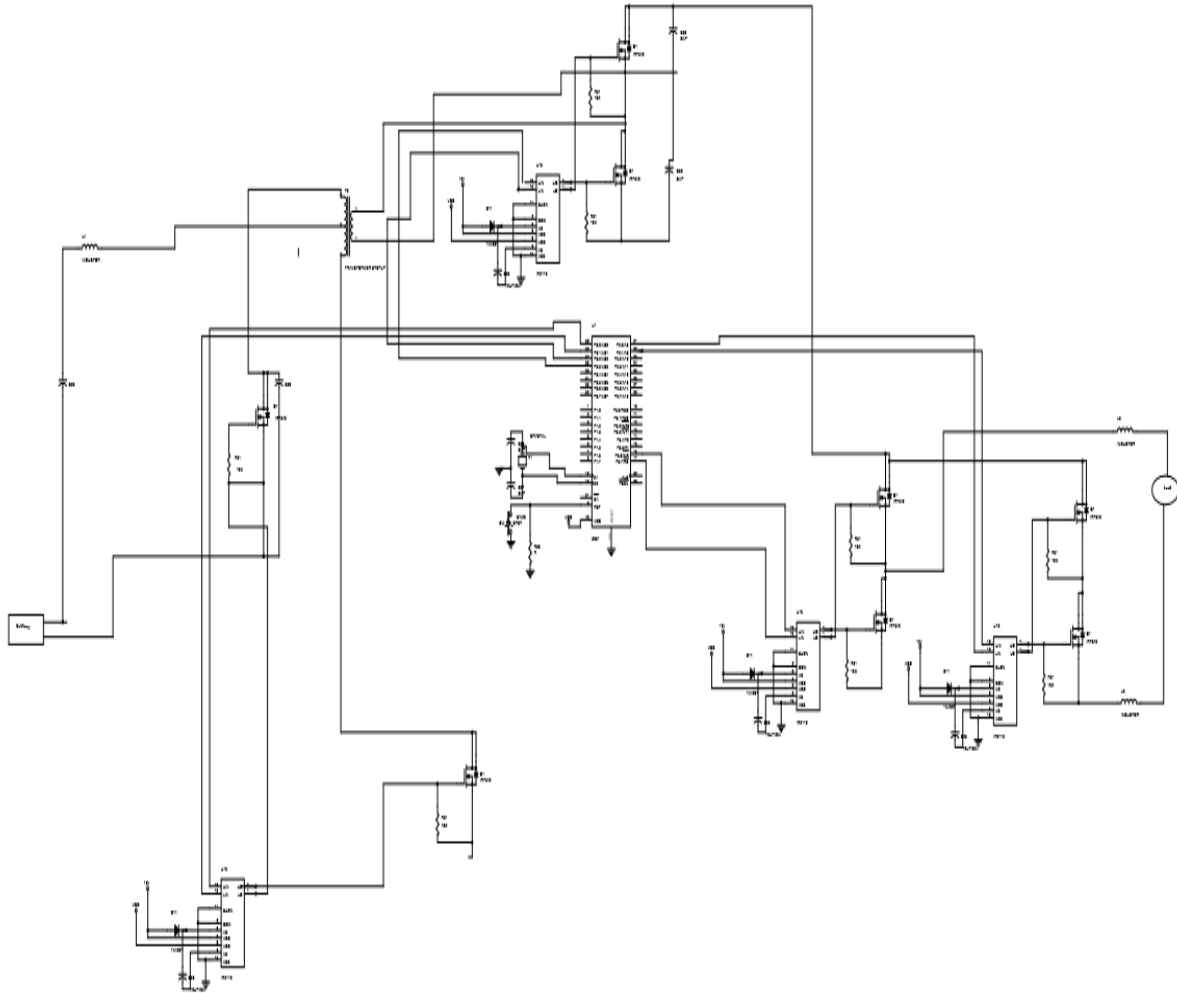
**Fig.1** Circuit Diagram

### 1.1. Current Fed Push Pull Stage

This is first stage which consists of current fed push pull converter with voltage doubler secondary side rectifier. The circuit operation is similar to current fed push pull converter which provides electrical isolation and converts DC voltage to DC current. The primary side switches should have a duty ratio greater than 50%. The overlap region of gate pulses lead to energizing of inductor L. When one of the switches is turned OFF, the source voltage aids the inductorstored energy and an eminentvoltage appears at primary windings.The secondary side is a voltage doubler circuit and output voltage is double the secondary winding voltage .The secondary side rectifier operation is to take an AC voltage as input and output as doubled DC voltage.

Thusby taking peak to peak ripple current to be 25% of inductor current. The turns ratio is determined by the required output voltage considering the fact that the secondary is a voltage doubler circuit and secondary voltage needs to be half of the output voltage.

### 1.2 Inverter stage

Inverter stage is a single phase full bridge inverter circuit. The output of the full bridge circuit is a pulsating DC and is filtered by a LC filter. The corner frequency of the LC filter is chosen far below the switching frequency to minimize the Total Harmonic Distortion in the output voltage. The 400V DC is converted to 230V AC in this stage.

### 1.3 Simulation Of Proposed System

The simulation of inverter circuit is carried out in MATLAB/Simulink. The modeldeveloped is shown in fig.2. The first stage is a current fed push pull converter, in which input is fed with 12V battery. The control circuit usedis shown in fig.3. A triangular signal of 40 KHz is compared with the duty cycle of 0.73. A delay of

50% between the PWM pulses for SP1 and SP2 is provided. Two diodes and capacitor combination at the transformer secondary acts as a voltage doubler circuit. The voltage obtained at the transformer secondary gets doubled and a 400V DC voltage is obtained.

The output of first stage is the input to the single stage SPWM inverter. The control circuit used for inverter is shown in fig.4. A sine wave is compared with a triangular wave of 20 KHz. The LC filter smoothes the output voltage to get a pure AC sinusoidal signal. The input voltage and current waveform is shown in fig.5. AC output current waveform is shown in fig.6. AC output voltage and current waveform from the inverter is shown in fig.7.The output of Inverter pulse is shown in fig.8. The output of Converter pulse is shown in fig.9.

## III. Figures
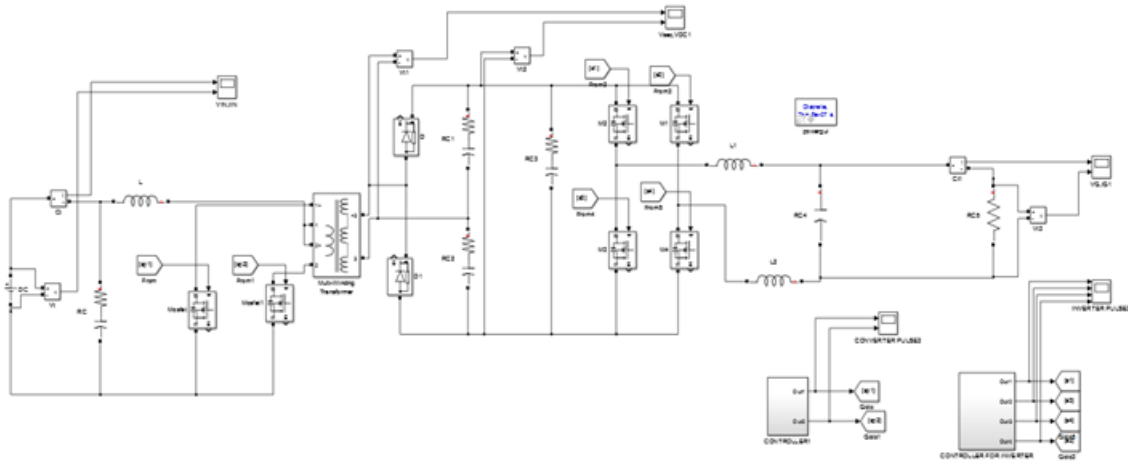


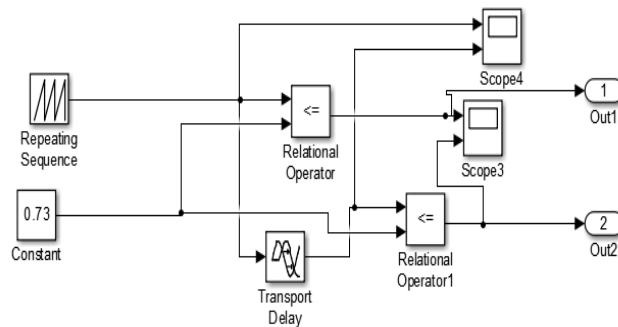**Fig.2:** Simulation of inverter


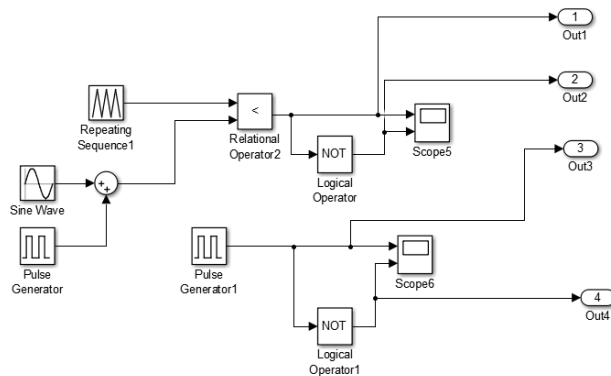
**Fig.3:** Controller for push pull converter



**Fig.4:** SPWM Controller  for inverter

## IV. Conclusion

The reduction in use of low frequency transformer and its losses led to the development of cascade current fed push pull converter and a single stage SPWM inverter. The detail of current fed push pull converter and the design is expalained.The design of filters at the inverter output is also explained.Then the justification of design model is done by simulation in MATLAB /simulink.The simulation results are obtained.The input and output waveforms are shown.The simulation results proves that this cascaded converter model provides high efficiency for the loads.
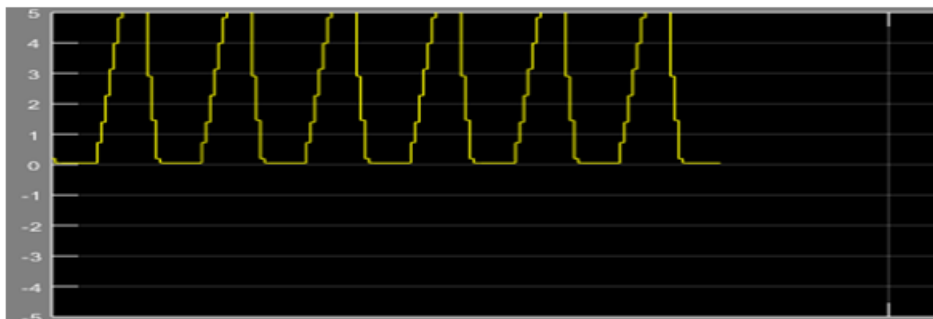


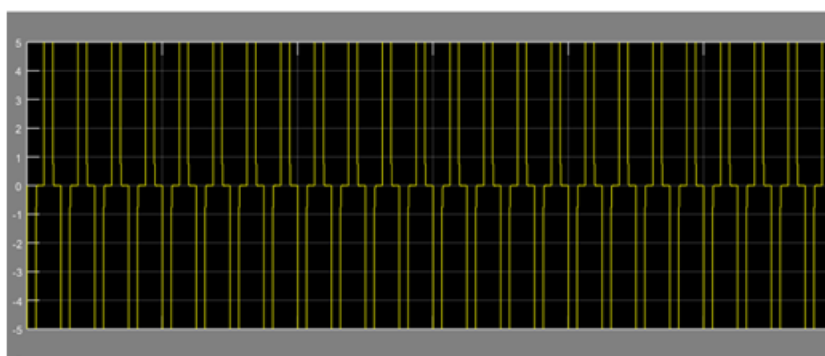**Fig.5:** Input voltage and current waveform
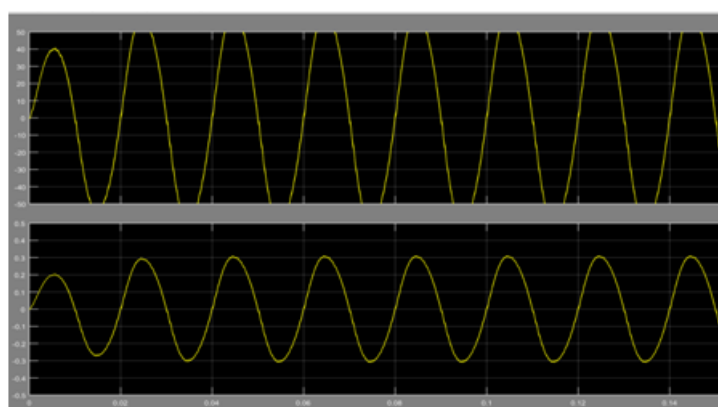


**Fig.6:** AC output current waveform



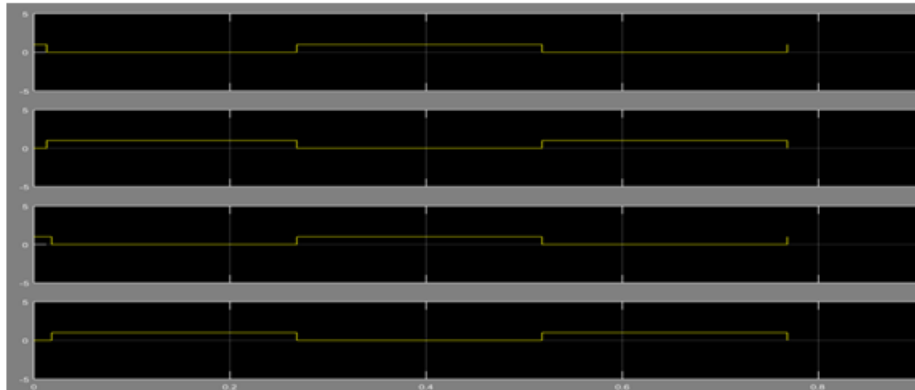**Fig.7:** AC output voltage and current waveform
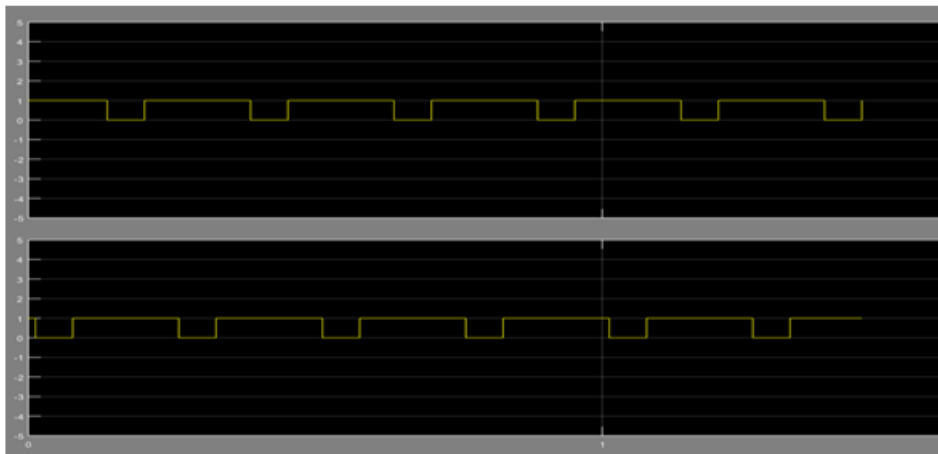
**Fig.8:** Inverter pulse



**Fig.9:** Converter pulse

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