

## Construction and Implementation of 1 KVA Inverter

J. C. Osuwa and C. F. Peter

Department of Physics, Michael Okpara University of Agriculture, Umudike, PMB 7267, Abia State, Nigeria

**Abstract:** The use of inverters in preference to generators as an alternative for un-interruptible power supply is gaining wide acceptability in developing countries, due to inverters' greater environmental compatibility. However, the major challenge remains local production of sufficiently high powered inverters for big loads and longer periods of time. In this study, effort is made to produce a robust 1 KVA inverter. Requirements for the implementation include locally sourced 80 Ah 12V deep cycle battery, IC SG3524 oscillator, MOSFETs and BJT types of transistors, diodes, transformer, relay, contactor, resistors, capacitors and other electronic components. The construction is divided into four units consisting of oscillator unit, MOSFET assembly unit, Transformer unit and battery charger monitor unit. Each constructed unit was independently tested for proper functionality before the composite coupling. The assembled composite unit worked successfully well. Oscilloscope measurements tallied with set frequency of 50 Hz, switching period of 0.02 seconds and square wave oscillator output. The system is capable of providing power to adequate loads for up to six hours.

**Keywords:** Inverter, MOSFETs, transistors, battery, contactor, transformer.

### I. Introduction:

Solid state electronics have revolutionized modern technology and brought about new ways of achieving set objectives. Driven by incessant power outages in developing countries, like Nigeria, the production of solid state inverters provides environmentally friendly alternative for un-interruptible power supply for the operation of different gadgets and for sustainable economy. This study is thus anchored on the production of 1 KVA inverter for provision of power using locally sourced 80 Ah 12 volts deep cycle battery, oscillator driven MOSFETs and a transformer along with other electronic components.

In building an inverter for the conversion of DC to AC at a normal frequency of 50 hertz, due consideration is given to the switching speed of the oscillator used to ensure that the MOSFETs in their two channels operate in their saturation and cut off states when appropriately driven by oscillator outputs in a way to complement each other [1]. Due considerations are also given to the transformer and other switching devices used as discussed in the subsequent sections of this paper.

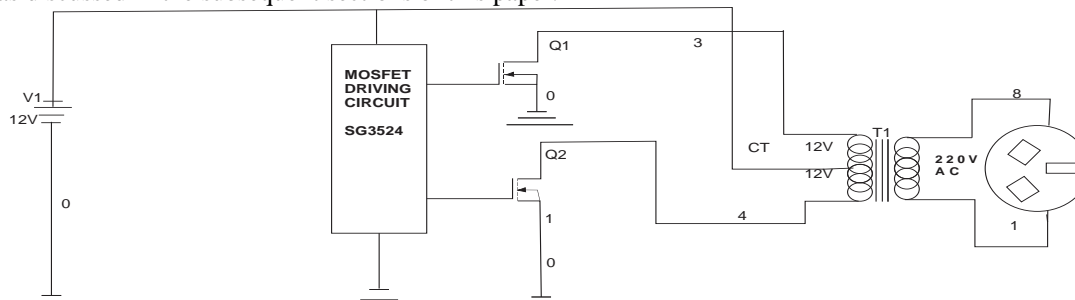


Fig. 1: Circuit diagram for the working Principles of an Inverter

### II. Basic Operation of an Inverter

The basic working principles of an inverter can be explained with the aid of Fig.1. The inverter operates by performing two functions. First, it converts the incoming DC from the feed battery to AC using a pair of powerful MOSFETs ( $Q_1$  and  $Q_2$ ) acting as very efficient electronic switches. Then, it steps up the resulting AC into equivalent mains voltage with corresponding frequency and phase, using appropriate step up transformer.

As shown in Fig.1, the positive 12V from the battery is connected to the centre tap of the transformer primary, while each MOSFET is connected between one end of the primary and earth. So by switching on  $Q_1$ , the battery current can be made to flow through the top half of the transformer primary and to earth through  $Q_1$ . Conversely, by switching on  $Q_2$  instead, the current is made to flow the opposite direction via the lower half of the primary and to earth. Thus, by switching on the two MOSFETs alternately, through an oscillator at a frequency of 50 hertz, an AC voltage is applied across the primary windings, which induces an AC voltage in the secondary windings [2]. More powerful inverters can be produced through the use of a number of MOSFETs per channel and appropriately connected battery bank [3].

### III. Component Units

Fig.2 shows the block diagram of the component units discussed below.

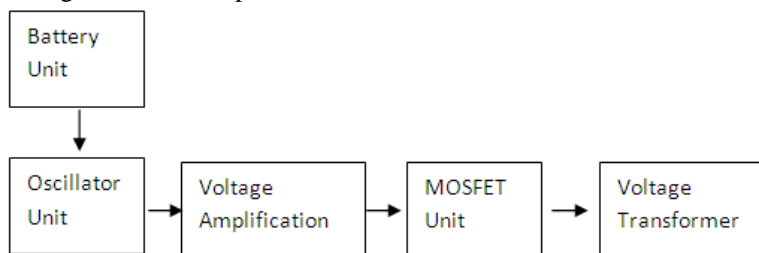


Fig.2: Block Diagram of sub-units

#### a. Oscillator (Frequency) Unit.

An oscillator can be thought of as an amplifier which generates or provides itself with an input signal and an output frequency which is determined by the characteristic of the selected device [4-5]. To cause the oscillation to be self driven, the signal feedback must be regenerated (positive feedback) [6].

The oscillator used in this work is IC SG3524. The frequency of oscillation of the IC SG3524 is programmed by  $R_T$  and  $C_T$  of the oscillator according to the approximation formula:

$$F = \frac{1.18}{R_T C_T}$$

where  $R_T$  is the timing resistor in  $K\Omega$  (ranges from 1.8  $K\Omega$  to 100 $K\Omega$ ) and  $C_T$  is the timing capacitor in  $\mu F$  (ranges from 0.001 $\mu F$  to 0.1 $\mu F$ ). In the present case, 23  $K\Omega$  was selected through a variable resistor and a mica capacitor of code 104 for  $C_T$  was used. Thus for  $R_T = 23 K\Omega$  and  $C_T = 0.1 \mu F$  the frequency is given by:

$$F = 1.18 / (23,000 \times 0.1 \times 10^{-6}) = 50 \text{ Hz.}$$

Thus, the switching period T is 0.02 seconds.

#### b. MOSFET Assembly unit

This unit consists of an array of MOSFETs. The MOSFET used in this construction is the depletion mode MOSFET with path number IRFP150N and the following data sheet parameters: current rating = 39A, voltage rating = 100V and power rating = 190W. The required number of MOSFETs per channel as determined for 1KVA inverter is given by  $1000/190 = 5.3$ . Thus, 6 MOSFETs are required per switching channel to be connected in parallel to boost the current to drive the transformer.

#### c. Transformer unit

A single transformer was used for this construction. The number of secondary windings is obtained from the approximate design equation for 50Hz transformer using laminated E-core as:

$$\text{Secondary turns} = \frac{48 \times \text{Output voltage}}{\text{core area}}$$

leading to a calculated value of 290 turns. The primary winding was obtained from the voltage transformation ratio of a transformer as follows:

$$E_2/E_1 = N_2/N_1$$

$$\text{Thus, } N_1 = E_1 N_2 / E_2 = (12 \times 290) / 220 = 16 \text{ turns.}$$

#### d. Battery Charger monitor unit

This unit is responsible for cutting off (or regulating) the charging of the feed battery to prevent excessive charging of the battery. It consists of transistors, resistors, diode, zener-diode and a 12V relay device as shown in the circuit of Fig. 3.

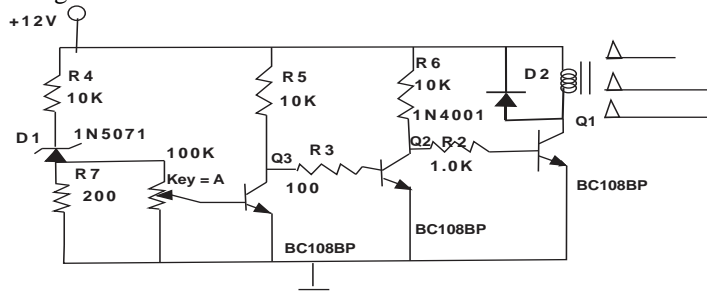


Fig.3: Charge monitor Circuit (<http://www.swagtaminnovations>)

#### IV. Assembling of Components and Testing

Following the construction of the various component units, they were independently tested to ensure they were working properly and any detected errors were corrected. The various components were then assembled to obtain a composite unit in the form shown in the circuit diagram of Fig.4. The assembled complete unit was further tested and found to work efficiently according to the specifications used. Oscilloscope measurements were found to tally with the set frequency value of 50Hz, switching period of 0.02 seconds and square wave oscillator output.

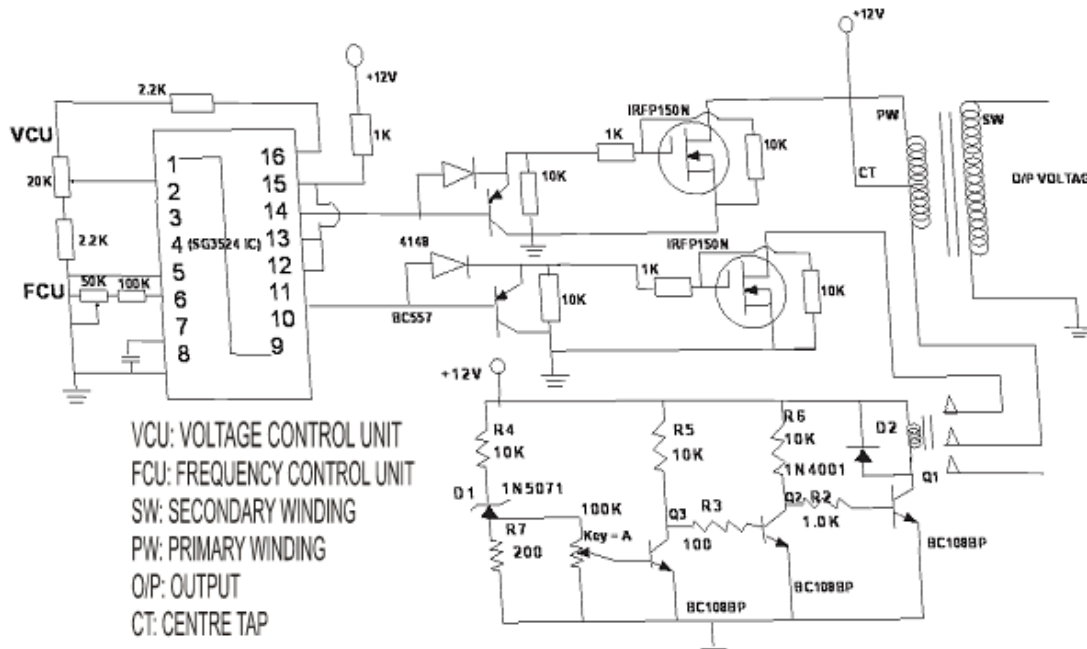


Fig.4: Complete typical circuit diagram of an Inverter. (<http://www.homemadecircuit.com>)

#### V. Conclusion.

A 1 KVA power inverter using 80 Ah 12 V deep cycle battery and capable of providing power to adequate load for up to six hours has been successfully constructed and implemented. The device consists of six parallel MOSFETs per channel, IC SG3524 oscillator that provides switching frequency of 50 Hz to the MOSFETs, transformer that steps up the voltage to 220V, a charging unit for the battery, an interfacing magnetic relay, diodes and a host of other electronic components. Satisfactory performance of the inverter according to specifications was confirmed with oscilloscope measurements. Subsequent productions of higher powered inverters are envisaged as well as recommended.

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