MEDIUM-POWER LOW-COST INVERTER

■ T.K. HAREENDRAN

This medium-power inverter is capable of generating approximately 300VA power. You can power the inverter from your car battery to generate 50Hz AC supply. The inverter provides enough back-up power to light up up to three 100W bulbs for up to two hours, provided the car battery is fully charged.

Fig. 1 shows the block diagram of the medium-power inverter. The power house comprises car battery, power supply, oscillator-cum-divider, driver, inverter transformer, power amplifier, buzzer and battery-level indicator sections. To keep the cost low, the charger circuit has not been included here. The car battery can be charged through the car battery charger circuit whenever it discharges.

The circuit

Connect the car battery to the circuit using crocodile clips. The red clip should be connected to the positive terminal of the battery and the black clip should be connected to the negative terminal of the battery. If crocodile clips are connected to the wrong terminals of the battery, LED1 glows to alert you.

Now flip switch S1 towards 'on' position to enable the circuit. LED3 glows to indicate power-'on' and 12V DC reaches regulator IC 7805 (IC1). The regulated output is fed to the oscillator-cum-divider and driver while the centre terminal of the inverter transformer primary is connected to the positive terminal of the car battery through high-currrent carrying wires. Capacitor C1 functions as a reservoir capacitor.

Low-battery indicator. For long life of the battery, it should not be allowed to discharge to a voltage below 10V. Even a single event of deep discharge can reduce the charge-holding capacity of the battery permanently.

For audio-visual indication of the low-battery level, a dual operational amplifier IC LM358 has been used. A fixed reference voltage of 5.1V is applied to its positive input, while the sensing voltage is applied to its negative input. Set preset VR1 such that the piezobuzzer sounds when the on-load battery voltage falls below 10V DC.

When the battery voltage drops below 10V, the sense input voltage drops below 5.1V and output pin 1 of IC4 goes high to sound the buzzer and light up LED2.

Oscillator-cum-divider. The oscillator-cum-divider section is built around timer IC LM555 (IC2) and dual J-K flip-flop 7473 (IC3). Only one flip-flop of the dual JK flip-flop is used here.

Timer LM555 is wired as an astable multivibrator, whose time period is decided by resistors R7 and R8 and capacitor C5. It produces 100 Hz at output pin 3, which is given to pin 5 of the J-K flip-flop to produce 50 Hz with 50% duty cycle. When the inverter is switched on using switch S1, IC2 starts producing 100 Hz, while the J-K flip-flop produces 50 Hz at its output pins 8 and 9. The output of timer IC2 can be checked using the oscilloscope at test point (TP).

Driver circuit. The flip-flop output is fed to MOSFET driver transistors T1 and T2 via a diode-resistor combination. At any instant, if the voltage of pin 8 of IC3 is +5V, the voltage at its pin 9 will be 0V, and vice versa. Therefore when transistor T1 conducts, transistor T2 is cut off, and vice versa. Whenever output pin 8 of IC3 goes high, npn transistor T1 conducts and the corresponding set of MOSFETs (T3

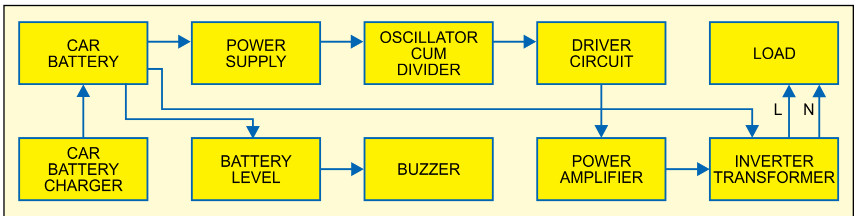

Fig. 1: Block diagram of medium-power inverter

PARTS LIST

Semiconductors:	
IC1	– 7805 5V regulator
IC2	– LM555 timer
IC3	– 7473 dual J-K flip-flop
IC4	– LM358 dual operational amplifier
T1, T2	– BD139 npn transistor
T3-T8	– IRFZ44 power MOSFET
D1, D2	- 1N4148 diode
LED1, LED2	– 5mm red LED
LED3	– 5mm green LED
ZD1, ZD2	- 5.1V zener diode
Resistors (all ¼-watt, ±5% carbon, unless mentioned otherwise):	
R1-R3, R5, R6 R9-R12	– 1-kilo-ohm
R4	- 1-ohm, 0.5W
R7	- 220-ohm
R8	- 15-kilo-ohm
VR1	- 470-kilo-ohm preset
Capacitors:	
C1, C3	– 0.1µF ceramic disk
C2	– 1000µF, 35V electrolytic
C4	– 100µF, 25V electrolytic
C5	– 0.47µF ceramic disk
C6	– 0.01µF ceramic disk
Miscellaneous:	
S1	– On/off switch
PZ1	– Piezobuzzer
X1	– 12V-0-12V primary to 300VA inverter transformer
	- Crocodile clips (red and black)
	- Multistrand high-current carrying wires

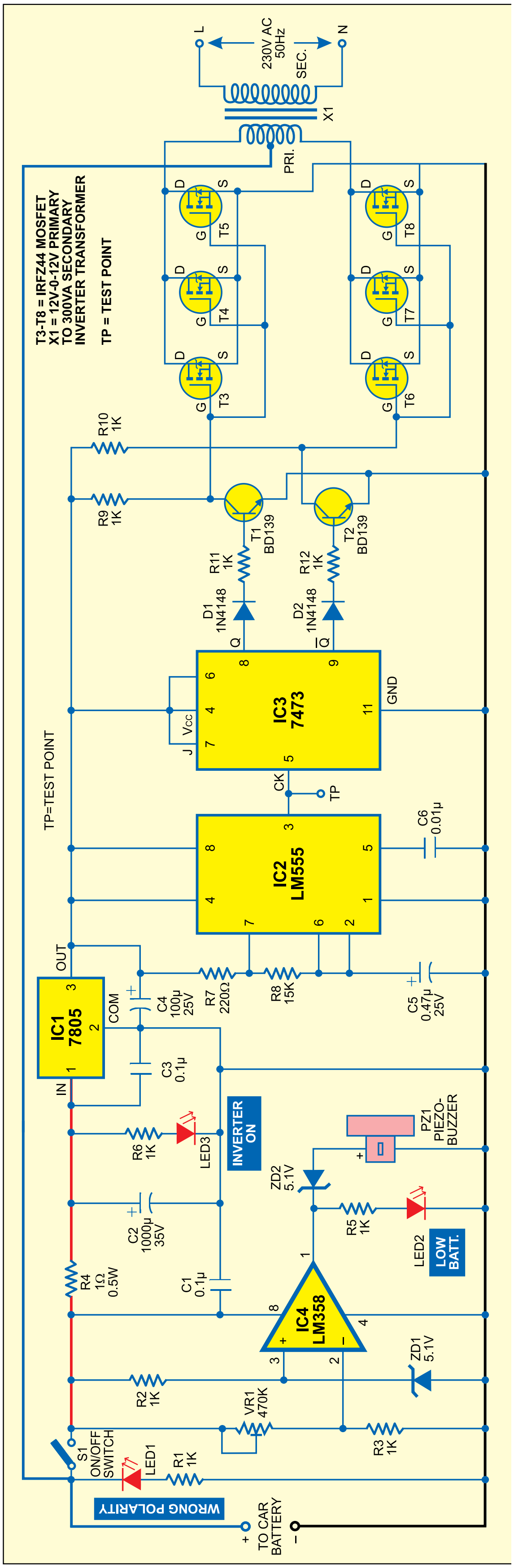

Fig. 2: Circuit of medium-power inverter

through T5) remains cut off while the collector of transistor T2 is at 5V. Thus current flows through half of the inverter transformer's primary winding. Similarly, when output pin 9 of IC3 goes high, npn transistor T2 conducts and the corresponding set of MOSFETs (T6 through T8) remains cut off while the collector of transistor T1 is at 5V. Thus current flows through the inverter transformer's primary winding.

Power amplifier. The power amplifier section comprises two sets of three power MOSFETs (IRFZ44) connected in parallel for operation of the inverter. The output of IC3 drives the MOSFETs (T3 through T5, and T6 through T8) via transistors T1 and T2 to generate 50Hz, 230V AC at the output of inverter transformer X1.

Fabrication

You can assemble the circuit on any general-purpose PCB. However, an actual-size, single-side PCB for the medium-power inverter circuit is shown in Fig. 3 and its component layout in Fig. 4. Pin configurations of MOSFET IRFZ44, regulator IC 7805 and npn transistor BD139 are shown in Fig. 5.

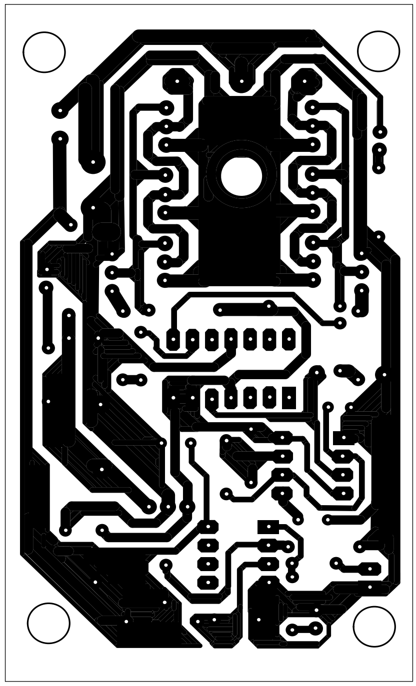

Fig. 3: Actual-size, single-side PCB for medium-power inverter

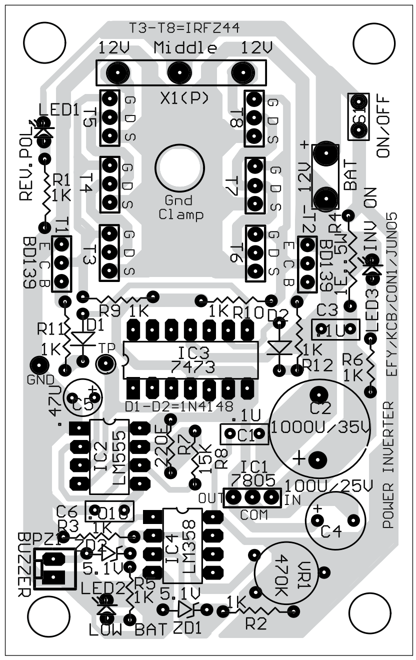

Fig. 4: Component layout for the PCB

After construction, enclose the entire circuit in a portable box (see Fig. 6). The first MOSFET set comprises T3, T4 and T5, and the second MOSFET set comprises T3, T4 and T5. Use separate heat-sinks for each MOSFET set. Since MOSFETs T3 through T5, and T6 through T8, are connected in parallel, connect the drains of the

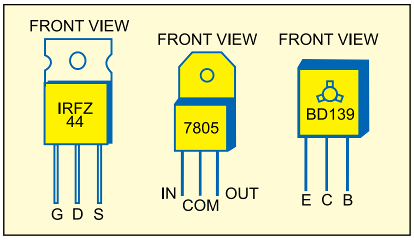

Fig. 5: Pin configurations of MOSFET IRFZ44, regulator IC 7805 and npn transistor BD139

MOSFETs (internally connected to the backplate having a through hole) using a copper/brass nut/bolt onto the respective common heat-sink. Mount all the status LEDs, piezobuzzer and switches on the front panel. Use heavy-gauge, multistrand battery wires (2.5 sq. mm or more) for the following DC connections:

1. From positive battery terminal to the middle of transformer X1 primary.

2. From the negative terminal of the battery to the common ground on the PCB using copper/brass nut and bolt (provision for the same is made on the PCB).

3. From each heat-sink set (where the drains of the MOSFETs have been connected using nuts and bolts) to the respective primary terminals of transformer X1.

EFY. Following additional precautions may also be taken:

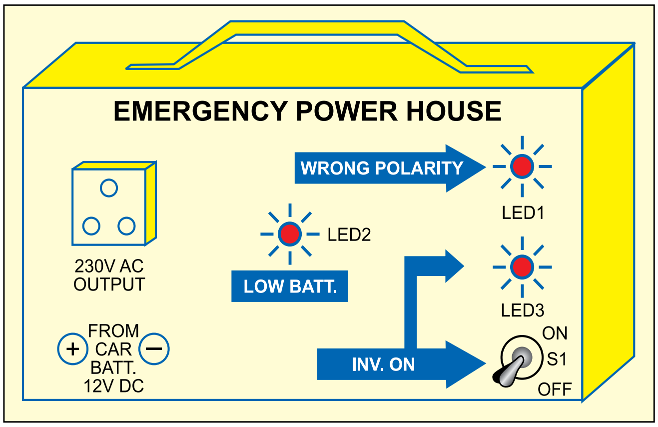

Fig. 6: Proposed portable box

1. On full load, the current drawn from the battery could be as high as 30 amperes. Therefore the ground track around source terminals of the MOSFETs on the PCB may be strengthened by depositing additional solder.

2. You may add a resistor (0.5-ohm rated at 20W) in series with positive battery lead going to the middle terminal of transformer X1 primary. In the case of excessive current being drawn by any of the MOSFETs (due to shorting, etc), only the resistor will burn, which can be easily replaced. ●