Description of function:

The inverter chops the 12 Volt DC Battery voltage into a square wave voltage of 50 cycles per second and duty cycle of 25%, transformed by transformer Tr1 to 230 Volt rms. IC1 forms the oscillator with 100 cycles per second (120 cycles per second for 60 cycles output). Frequency is determined by C1 and the resistors R4 and R5. Resistor R6 determins the time of the flyback of the oscillator and affects likewise the frequency. In addition, R6 affects the rms of the output voltage, which must be considered if necessary, if the circuit shall be used for other frequencies. 60 cycles per second can be achieved by alignment, higher frequencies require changes in the frequency-determining parts. For high stability of frequency, special attention must be spent on condenser C1. Ceramic capacitors are not usefull, due to their high sensitivity on temperature. Most foil condensers may keep the frequency quite constant, even against strong temperature variations.

IC2 determines the pulse width and thus rms of the output voltage. The regulater consists of transistor T1, which receives its signal from the diodes D4 and D5, taken from the primary tranformer coil. The regulator adjusts the output voltage by changing the pulse width. It prevents also rising of rms on inductive or capacitive load. The characteristics of regulation can be adapted by changing D4 (important on 24 Volts applications!). Lower voltage level of D4 results in "softer" regulation, i.e. an reduction of the proportional factor.

Against earlier versions of the inverter, IC 8 now will be switched directly by the oscillator signal, thus avoiding errors by unexpected oscillations of the PWM-IC 2. Here the alternate allocation of the impulses for both transistor lines, i.e. for the positive and the negative half wave of the output voltage takes place. The final frequency of 50 cycles per second develops. Flip-flop IC7 stores a switching off instruction of the current limiter for the rest of the half wave. From the gates IC5 (4093-III) and IC6 (4093-IV), the control signal arrives at the complementary MOSFET-driver stage transistors T5/T6 and T7/T8. T6 and T7 are N-channel-enhancement mosfets and T5 and T8 are the complementary P-channel-enhancement mosfets. These transistors correspond to the well-known CMOS basic circuit (CMOS = Complementary MOS), which represents the basic of the CMOS logic family (CMOS inverters). Only the resistors R44 to R47 are new in this circuit. They provide current limitation during shifting process and protect in cases of disturbances. The control unit ist suitable for inverters up to 10 kW output power. The driver stage transistors T5 to T8 provide the signals for the power mosfets, which alternately magnetize transformer Tr1. Inductive idle currents, how they are needed e.g. by electric motors, can be returned to the battery, thanks to the integrated antiparallel recirculating diodes of the transistors. Thus they do not generate unnecessary losses, contrary to early inverters.

The most important task in our inverter is done by the mosfet transistors T13 to T28. They are connected in two groups, each of 8 transistors. They generate alternatingly the positive and negative wave of the output voltage. Each transistor line works on ist own transformer coil. After a transistor line is beeing switched off, the magnetic energy stored in the magnetic field of the transformer returns back to the battery by the integrated recirculation diodes of the second transistor line. The idle current of consumers with inductive load takes the same way. In case of strong heating up of the transistors, which should only happen on defects in the equipment, the bimetal thermal switch F2 shuts off the control electronics. In normal operation, temperature of the heat sink should be as low, that you could touch it by your hands.

The source-currents of the mosfet transistors pass over resistor R20 with the very low value of 0.001 ohms. Load currents of 100 amperes thus produces a voltage drop of only 0.1 Volt, according to an energy dissipation of 10 Watts. The electronic current limiter becomes effective for currents above 350 Amperes, i.e. on voltage drops on R20 of more than 0.35 Volts. Main cause for such high currents are short-circuits or consumers with "large" inductances, e.g. welding transformers or large battery chargers, which exhibit remanence magnetism. Also large electrolytic capacitors from switching power supplies cause immense peak currents (computer screen), just as asymmetrical load of devices with single period rectifiers or thyristor regulaters, which cause a magnetical bias to the transformer of the inverter.

The electronic overload protection by IC9 is a special feature of our inverter. It needs a additional negative supply voltage, which is produced by a charge pump, consisting of IC10 and the transistors T9 and T10. IC9 works as threshold switch (Schmitt trigger). Sensitivity can be affected by change of the value of R22. A value of 1.5 kOhm means e.g. shutdown at lower currents (for inverters with smaller power output.

While starting the inverter, the negative supply voltage from the charge pump will be missing. This leads to immediate shutdown of the power mosfets, indicated by the red LED1. Thus indefinable control signals, that could result in unwanted switching, which would force small batteries to break down, are prevented. Our inverter therefore requests no maximum or minimum battery size - it works on any 12 Volt power supply. If the electronic overload protection becomes active, a positive output signal will be present at pin 6 of IC9. Through resistor R13 the flip-flop IC7 is set, which keeps the blockage upright until the next half wave on pin 11 appeares. IC7 may be closed likewise by transistor T3, which receives its signal from the optional "load detection" . If no load is detected, the inverter will be shutdown by this circuitry in order to save battery power.

Sensitivity of the shutdown circuitry may be tested by disconnecting the lead to resistor R20 and applying variable voltages at connector "C" in the range of 0 ... 1 Volt (important: transformer Tr1 must also be disconnected!). At approx. 0.35 Volts the red LED1 would light up and would get dark again at voltages of scarcely more than 0 Volt. Parallel to resistor R20 a 100 uA measuring instrument may be attached for display of load currents.

The optional "load detection" shall not be described here in detail. It consists of the circuit parts around resistor R33, transformer Tr2, relay1 and the ICs 12 and 13. If this part of the circuit shall not be used, the inverter would work in continuous operation. Thus T3, R10, R9, D6, R15 and D3 would be obsolete. The 230 Volts load would be connected directly to clamp 5 and 6 of transformer Tr1. The "load detection" recognizes an active load by a small DC through the contacts of relay1 and resistor R43. The inverter will be switched on for approx. 5 seconds. If then a load current would appear on R33, the inverter will remain switched on, indicated by LED2 (yellow). The limitation of the output power of 3000 Watts is due to power dissipation of R33. Instead of the "amateur-solution" of R33 and Tr2, a typical current transformer may be used. Some loads do not switch on the inverter, e.g. energy-saving lamps. For this the manual activation at port "G" is intended. A small 1 VA-transformer in parallel to the energy-saving lamp would also cause a DC-current and thus would solve the problem