Inverter welder schematic pdf

I'm not robot!

Welding inverter is an alternative to a conventional welding transformer. Modern semiconductors allow to replace the traditional mains transformer with a switching power supply, which is much lighter, smaller and allows easy current adjustment via a potentiometer. The advantege is also that the output current is DC. DC current is less dangerous than AC and prevents arc extinction. For this inverter i chose topology, which is the most common in welding inverters - forward converter with two switches. In my article about switchning supplies it is a topology II.D. Input mains voltage passes through an EMI filter and is smoothed with high capacity capacitors. Since the inrush current of those capacitors would be too high, there's a softstart circuit. After switching ON, the primary smoothing capacitors are charging via resistors, which are later bypassed by the contact of a relay. As power switches, IGBT transistors IRG4PC40W are used. They are driven through a forward gate-drive transformer TR2 and shaping circuits with BC327 PNP transistors. The control integrated circuit is UC3844. It's similar to UC3842, but it has its pulse-width limited to 50%. Working frequency is 42kHz. Control circuit is powered by an auxiliary power supply of 17V. Current feedback, due to high currents, is using a current transformer Tr3. Voltage drop accros the sensing resistor 4R7/2W is approximately proportional to the output current. Output current can be controlled by potentiometer P1, which determines the threshold of the current feedback. Threshold voltage of the pin 3 of UC3844 (current sensing) is 1V. Power semiconductors require cooling. Most of the heat is dissipated in output diodes. Upper diode, consisting of 2x DSEI60-06A, must in worst case handle the average current of 50A and the dissipation of 80W (total of both diodes). Lower diode STTH200L06TV1 (doube diode package with both internal diodes connected in parallel) must in worst case handle an average current of 100A and the dissipation of nearly 120W. Maximum total dissipation of the secondary rectifier is 140W. The heatsink must be able to handle it. To the thermal resistance you must include the junction-case Rth, case-sink Rth and sink-ambient Rth. DSEI60-06A diodes don't have insulation pads and the cathode is connected to the the heatsink. Output choke L1 is therefore in the negative rail. It is advantageous because in this configuration, there's no high-frequency voltage on the heatsink. You can use another type of diodes, for example a parallel combination of a sufficient number of the most accessible diodes, such as MUR1560 or FES16JT. Note that the maximum average current of the lower diode is twice the current of the upper diode. Calculation of the power dissipation of the IGBTs is more complicated because in addition to conductive losses there are also switching losses. Loss of each transistor is up to about 50W. It is also necessary to cool the reset diodes UG5JT and the mains bridge rectifier. The power dissipation of the reset diodes depends on the construction of Tr1 (inductance, stray inductance), but is much lower than the dissipation of the IGBTs. The rectifier bridge has a power dissipation of up to about 30W. UG5JT diodes and the rectifying bridge are placed on the same heatsink as the IGBTs. UG5JT diodes also can be replaced with MUR1560 or FES16JT or other ultrafast diodes. During construction it is also necessary to decide the maximum loading factor of the welding inverter, and accordingly select size of heatsinks, winding gauges and so on. It is also good to add a fan. Switching transformer Tr1 is wound on two ferrite EE cores, each with a central column cross section 16x20mm. The total cross section is therefore 16x40mm, the core must have no air gap. 20 turns primary winding is wound using 14 wires of a 0.5 mm diamater. It would be better to use 20 wires, but they didn't fit into my core. Secondary winding has 6 turns of a copper strip (36 x 0.5 mm). Forward gate-drive transformer Tr2 is made with an emphasis on low stray inductance. It is trifillary wound, using three twisted insulated wires of 0.3 mm diameter, and all the windings have 14 turns. Core is made of material H22, middle column has a diameter of 16mm, with no gaps. Current sensing transformer Tr3 is made from an EMI suppression choke on a toroidal core. The original winding with 75 turns of 0.4 mm wire works as a secondary. Primary has just 1 turn. Polarity of all the transformer windings must be kept (see dots in schematic)! L1 inductor has a ferrite EE core, middle column has cross section 16x20mm. It has 11 turns of a copper strip (36 x 0.5mm) and the total air gap in the magnetic circuit is 10mm. Its inductance is cca 12uH. The auxiliary 17V switching power supply, including Tr4, is described in more detail here. The simplest welding inverter on Pic 1 has no voltage feedback. Voltage feedback does not affect the welding, but affects the power consumption and heat losses in the idle state. Without the output voltage feedback there is quite high output voltage (approximately 100V) and the PWM controller ia running at its max duty cycle, thereby increasing the power consumption and heating of components. Therefore, it is better to implement the voltage feedback. You can inspire on Pic 2. The feedback can be connected directly because the controll circuit is isolated from mains. The reference voltage is 2.5V. Select the R2 to set the open circuit voltage. You can find useful info in datasheet of UC3842, 3843, 3844, 3845 or in its another datasheet. Inspiration for modifications you can also find in 3-60V 40A supply. Interesting links from which I drew: leszek/spawarki/ and a little modified: Warning: Inverter circuits are electrically connected to the mains. Inverter contains large capacitors that can remain charged even after turned off and disconnected from mains. Some components (electrolytes, IGBT, ...) can explode at fault condition. Inverter output voltage is dangerous. If defective or poor construction, the mains voltage or voltage higher than required can appear at the output. Inverter can cause electric shock, burns or fire. The arc creates a very intense light (with a large part of ultraviolet), from which people should be protected. It can cause permanent eye damage and skin burns. Welding generates toxic gases, they must be ventilated. You do everything at your own risk and responsibility. Pic 1 - Homemade inverter welder (welding inverter) schematic - click to enlarge. Pic 2 - Voltage feedback addition. Tr1 Secondary made of a copper strip Secondary winding with a transformer paper insulation on top. Then I added an insulation tape (about 10 layers) for an extra insulation. Secondary with a half of the core Tr1 with wound primary. Note that the primary doesn't go to the edges, so it can't cut to the secondary. switching transformer Tr1 with core Old Czechoslovak switching supply from the mainframe (5V 50A DBP 236 Kosire ZPA). From two such supplies I salvaged parts for the construction of the inverter (ferrites, heatsinks, distance posts, spools, inductors, copper strips, ...) Diodes STTH200L06TV1 and DSEI60-06A ultrafast diodes on the heatsink heatsink with diodes, TR1, L1 and copper strip Gate-drive transformer (GDT) TR2 with a trifillar winding Tests of the exciter UC3844, TR2 and shaping circuit Shaping circuit for gates Ready to first start :). Short-term test for 150A - all survived:). IGBT, bridge, reset diodes, forming circuits, GDT TR2 and the UC3844 driver. Current transformer TR3 It is welding :) Measurement of arc voltage - long arc Measurement of arc voltage - short arc Inverter with auxiliary supply in a temporary case. The first test (the short-circuit current). The second test, half the mains voltage, output voltage is too low to hold the arc. At the end you can se PWM on an oscilloscope. Third test - it is allready welding. Welding and safety at work - how it should never look like:). home If you are looking for an option to replace conventional welding transformer, the welding inverter is the best choice. Welding inverter is handy and runs on DC current. The current control is maintained through potentiometer.By: Dhrubajyoti BiswasUsing Two Switch TopologyWhen developing a welding inverter, I applied forward inverter with two switches topology. Here the input line voltage traverses through the EMI filter further smoothing with big capacity.However, as the switch-on current pulse tends to be high there needs the presence of softstart circuit. As the switching is ON and the primary filter capacitors charges via resistors, the power is further zeroed by turning the switching ON the relay.The moment the power is switched, the IGBT transistors gets used and are further applied through TR2 forward gate drive transformer followed by shaping the circuit with the help of IC 7812 regulators.Using IC UC3844 for PWM ControlThe control circuit used in this scenario is UC3844, which is very much similar to UC3842 with pulse-width limit to 50% and working frequency to 42 kHz.The control circuit draws the power from an auxiliary supply of 17V. Due to high currents, the current feedback uses Tr3 transformer.The voltage of 4R7/2W sensing register is more or less equal to the current output. The output current can be further controlled by P1 potentiometer. Its function is to measure the feedback's threshold point and the threshold voltage of pin 3 of UC3844 stands at 1V.One important aspect of power semiconductor is that it needs cooling and most of the heat generated is pushed out in output diodes.The upper diode which consists of 2x DSEI60-06A should have the capacity to handle the current at an average of 50A and loss till 80W.The lower diode i.e. STTH200L06TV1 also should the average current of 100A and loss till 120W. On the other hand, the total max loss of the secondary rectifier is 140W. The L1 output choke is further connected with the negative rail.This is a good scenario since the heat sink is barred from hi-frequency voltage. Another option is to use FES16JT or MUR1560 diodes.However, it is important to consider that the max current flow of the lower diode is twice the current to that of the upper diode.Calculating IGBT LossAs a matter of fact, calculating IGBT's loss is a complex procedure since besides conductive losses switching loss is another factor too.Also each transistor loses around 50W. The rectifier bridge also loses power till 30W and it is placed on the same heat sink as IGBT along with UG5JT reset diode.There is also the option to replace UG5JT with FES16JT or MUR1560. The loss of power of the reset diodes is also dependent upon the way Tr1 is constructed, albeit the loss is lesser compared to the loss of power from IGBT. The rectifier bridge also accounts to power loss of around 30W.Furthermore when preparing the system it is important to remember to scale the maximum loading factor of the welding inverter. Based upon the measurement, you can then be ready to select the correct size of the winding gauge, heat sink etc.Another good option is to add a fan as this will keep a check on the heat.Circuit DiagramTransformer Winding DetailsThe Tr1 switching transformer is wounded two ferrite EE core and they both have the central column section of 16x20mm.Therefore, the total cross section calculates to 16x40mm. Care should be taken to leave no air gap in the in the core area.A good option would be to use 20 turns primary winding by wounding it with 14 wires of 0.5mm diameter.The secondary winding on the other hand has six copper strip of 36x0.55mm. The forward drive transformer Tr2, which is designed on low stray inductance, follows trifillar winding procedure with three twisted insulated wire of 0.3 mm diameter and the windings of 14 turns.The core section is made of H22 with the middle column diameter of 16mm and leaving no gaps.The current transformer Tr3 is made of EMI suppression chokes. While the primary has only 1 turn, the secondary is wounded with 75 turns of 0.4 mm wire.One important issue is to keep the polarity of the windings. While L1 has ferrite EE core, the middle column has the cross section of 16x20mm having 11 turns of copper strip of 36x0.5mm.Furthermore, the total air gap and the magnetic circuit are set to 10mm and its inductance is 12uH cca.The voltage feedback does not really hamper the welding, but it surely affects the consumption and the loss of heat when in idle mode. The use of voltage feedback is quite important because of high voltage of around 1000V.Moreover, the PWM controller is operating at max duty cycle, which increases the power consumption rate and also the heating components.The 310V DC could be extracted from the grid mains 220V after rectification via a bridge network and filtration through a couple of 10uF/400V electrolytic capacitors.The 12V supply could be obtained from a ready-made 12V adapter unit or built at home with the help of the info provided here:Aluminum Welding CircuitThis request was submitted to me by one of the dedicated readers of this blog Mr. Jose. Here are the details of the requirement:My welding machine Fronius-TP1400 is fully functional and I have no interest in changing its configuration. This machine that has an age is the first generation of inverter machines.It is a basic device for welding with coated electrode (MMA welding) or tungsten arc gas (TIG welding). A switch allows the choice.This device only provides DC current, this is very appropriate for a large number of metals to be welded.There are a few metals such as aluminum that due to its rapid corrosion in contact with the environment, it is necessary to use pulsating AC current (square wave 100 to 300 Hz) this facilitates the elimination of corrosion in cycles with inverted polarity and turn the melting in the direct polarity cycles.There is a belief that aluminum does not oxidize, but it is incorrect, what happens is that at the zero moment that it receives contact with air, a thin layer of oxidization is produced, and which from then on preserves it from next subsequent oxidization. This thin layer complicates the work of welding that's why AC current is used.My desire is make a device that be connected it betwen the terminals of my DC welding machine and the Torch to obtain that AC current in the Torch.This is where I have difficulties, at the moment of building that CC to AC converter device. I am fond of electronics but not expert.So I understand the theory perfectly, I look at the HIP4080 IC or similar datasheet seeing that it is possible to apply it to my project.But my great difficulty is that I do not do the necessary calculation of the values of the components. Maybe there is some scheme that can be applied or be adapted, I not find it on internet and I do not know where to look, that's why I ask for your help.The DesignIn order ensure that the welding process is able to eliminate the oxidized surface of an aluminum and enforce an effective welding joint, the existing welding rod and the aluminum plate could be integrated with a full bridge driver stage, as shown below:The Rt, Ct could be calculated with some trial and error to get the mosfets oscillating at any frequency between 100 and 500Hz. For the exact formula you could refer to this article.Th 15V input could be supplied from any 12V or 15V AC to DC adapter unit.

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