Adjustable 0-100V 50 Amp SMPS Circuit

The high power adjustable switching power supply is perfect for the purpose of laboratory work. The topology used to design the system is switching topology – half controlled bridge.

The switching supply is powered with IGBT transmitters and is further controlled by UC3845 circuit. The mains voltage goes straight through the EMC filter which is further checked and filtered on C4 capacitor.

As the capacity is high (50 amps), the inflow in the limiting circuit with Re1 switch and also on R2.

The relay coil and fan, taken from AT or ATX power supply is powered from 12V. The power is obtained via the resistor from 17V auxiliary supply.

It is ideal to select R1 so that the voltage at the fan and the relay coil limits to 12V. The auxiliary supply on the other hand uses TNY267 circuit and R27 facilitates protection from under-voltage of auxiliary power.

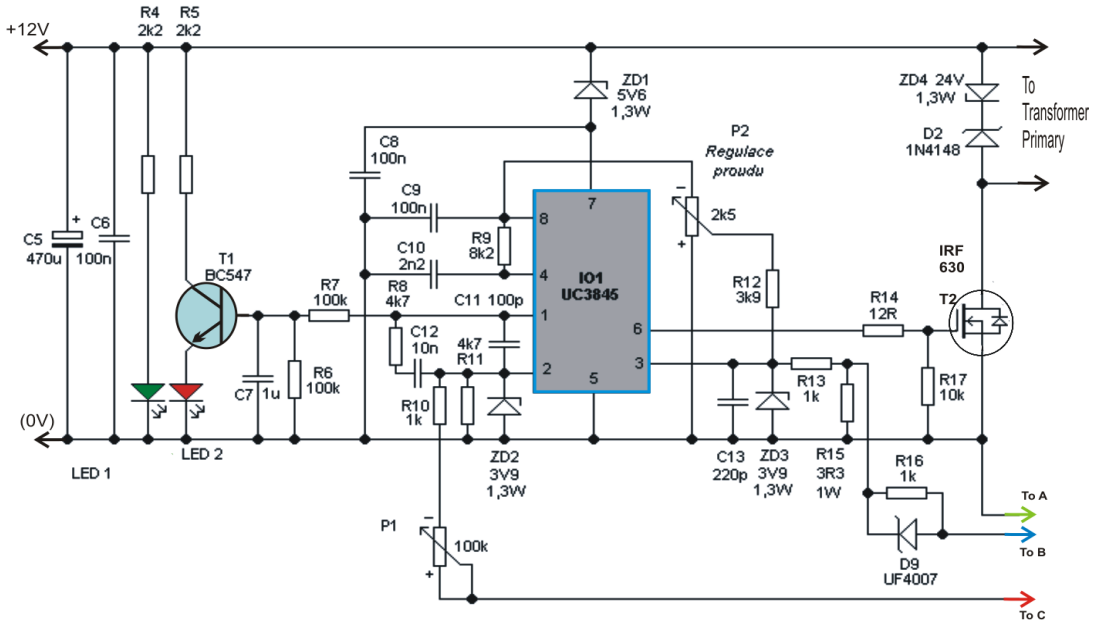
The power will not turn on if the current is less than 230V. The UC3845 control circuit results to 47% duty cycle (Max.) with the output frequency of 50 kHz. The circuit is further powered with the help of the zener diode, which actually helps to reduce the supply voltage and even helps to shift the UVLO threshold of lower 7.9V and upper 8.5V to 13.5V and 14.1V respectively.

The source initiates the power and starts working on 14.1V. It never goes below 13.5V and further helps to protect IGBT from desaturation. However, the original threshold of UC3845 should to set as low as possible.

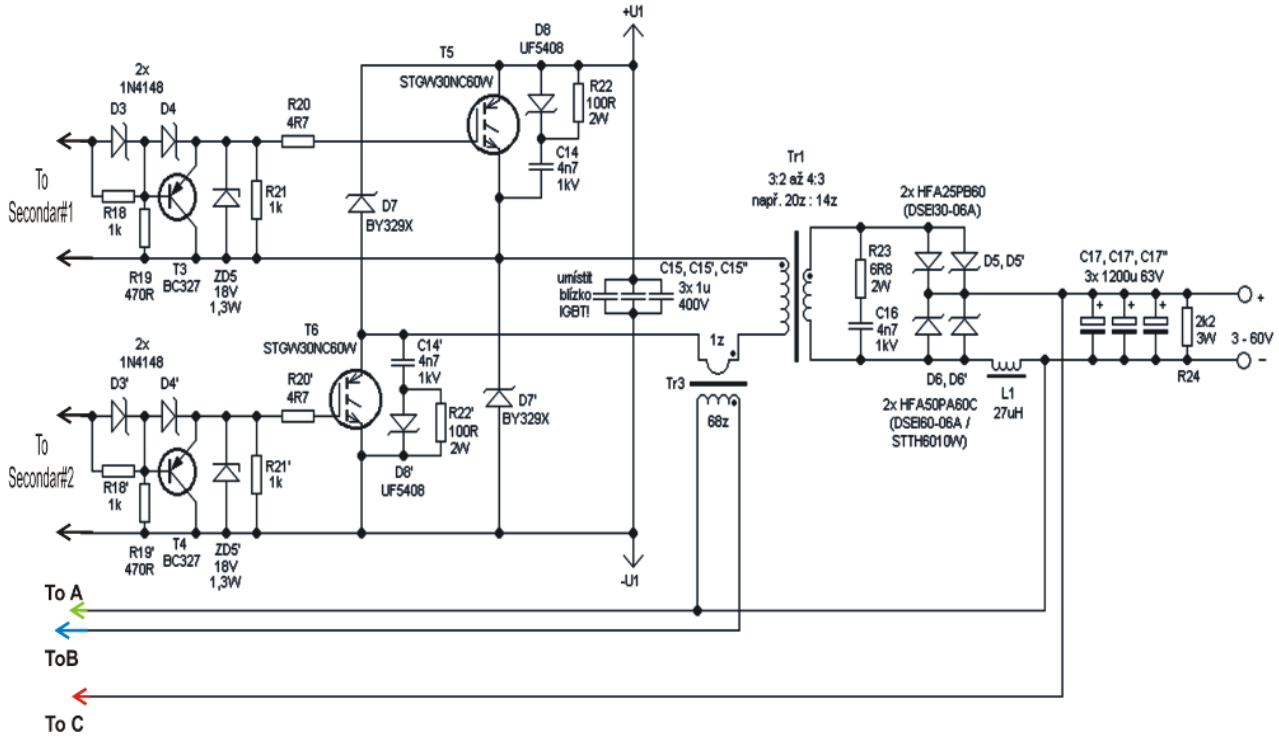
The MOSFET T2 circuit controls, which helps to make Tr2 transformer work offers floating drive and galvanic isolation for the upper IGBT. It is through the forming circuits of T3 and T4 that it helps to drive T5 and T6 of IGBT and the switch further rectifies line voltage to Tr1 power transformer.

As the output is rectified and reaches an average, it is smoothed by L1 coil and C17 capacitors. The voltage feedback is further connected from output to the pin 2 and IO1. Furthermore, you can also set the output voltage of power supply with P1 potentiometer. There is no need for galvanic isolation of feedback.

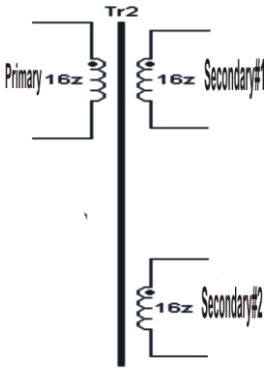
It is because the control circuit is connected with the secondary SMPS and leaves no connection with the network. The current feedback is passed through the current transformer TR3 right onto 3 pin IO1 and the overcurrent protection threshold can be set using P2.



12V input supply may be acquired from an ATX power supply



+U1 and -U1 may be derived from mains 220V input after appropriate rectification and filtration



Also, please remember to place diodes D5, D5 ', D6, D6', D7, D7 ', transistors T5 and T6 on heat sink along with the bridge. Care should be taken to place snubbers R22 + D8 + C14, capacitors C15 and diodes D7 close to IGBT. The LED1 signals the operation of the supply and LED2 signals the error or the current mode.

The LED glows when the supply has ceased to work in voltage mode. When in voltage mode, the IO1 pin 1 is set to 2.5V else it usually has6V. LED light is an option and you may exclude the same during making.

Inductance: For power transformer TR1, the transformation ratio is around 3:2 and 4:3 in primary and secondary. There is also air gap in the ferrite core which is EE shaped. If you are looking for to wind all by yourself, use a core as it is in an inverter which should size around 6.4 cm2.

The primary is of 20 turns with 20 wires with each having diameter measuring 0.5mm to 0.6mm. The secondary 14 turns with 28 diameters is also of the same measurement like that of primary. Moreover, it is also possible to create windings of copper strips.

It is important to note that application of single thick wire is not a possible idea because of the skin effect. Now since the winding is not required, you may wind the primary one first followed by secondary. Tr2 forward gate driver transformer possesses three windings having 16 turns each. It is by using three twisted insulated bell wires that all windings has to be wounded at once leaving any air gap at the wound of the ferrite core.

Next, taking the main power supply from AT or ATX power supply unit of a computer with the core section of

around 80 to 120mm2. The current Tr3 transformer is of 1 to 68 turn on ferrite ring and the number of turns or size is not critical here.

However, the process to orient the winding of transformers must be followed. Also you need to use double choke EMI filter. The output coil L1 has two parallel inductors of 54uH on iron powder rings. The total inductance is finally 27uH and the coils are wounded by two magnetic copper wires of 1.7mm in diameter, which makes the total L1 cross section to approx. 9 mm2.

The output coil L1 is attached to a negative branch which results no RF voltage in the cathode of diode. This facilitates mounting the same in heat sink without any insulation.

The max input power of the switched power supply is around 2600W and the resultant efficiency is above 90%. In switching power supply, you can use STGW30NC60W IGBT type or you can also use other variants like STGW30NC60WD, IRG4PC50U, IRG4PC50W or IRG4PC40W.

You can also use a fast output diode having adequate current rating. In the worst case scenario, the upper diode gets an average current of 20A while the lower diode in similar situation gets 40A. Thus it is better to use upper diode half-current than the lower one.

For upper diode, you can use, either HFA50PA60C, STTH6010W or DSEI60-06A else two DSEI30-06A and HFA25PB60. For lower or bottom diode you can use two HFA50PA60C, STTH6010W or DSEI60-06A else four DSEI30-06A and HFA25PB60.

It is important that the diode of the heat sink must lose 60W (approx.) and loss in IGBT may account to 50W. However, it is quite hard to ascertain the loss of D7 since it is dependent on Tr1 property.

Moreover, the bridge loss may account to 25W. The S1 switch enables shutdown in standby mode primarily because of the frequent mains switching may not be proper, specifically when using it for laboratory. In the standby state, the consumption is around 1W and S1 can be skipped.

If you are looking to construct a fixed voltage source of supply, it is also feasible but for the same it is better to apply transformer ratio of Tr1 for maximum efficiency, for instance, in the primary use 20 turns and in secondary use 1 turn for 3.5V – 4V.