BATTERY POWER SUPPLY FOR OSCILLOSCOPE

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ABSTRACT

This work deals with the problem of isolated power supply for oscilloscopes used in power electronics. The solution based on the flyback DC/DC converter (input 12V, output 300V) fed from the sealed lead acid battery is described.

1 INTRODUCTION

Due to safety rules the oscilloscope ground i.e. probe screening, must be connected to the line protective conductor (PE) as shown in *Fig. 1*.

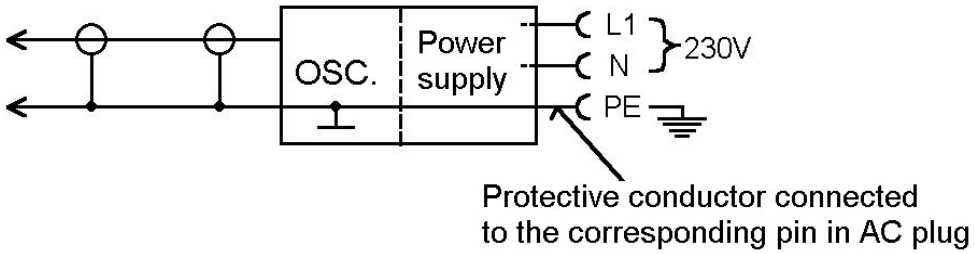

Fig. 1: *Oscilloscope connection to the mains*

This connection doesn´t matter for measurments in microelectronics when the measured circuit is allways isolated from the mains by laboratory power supply which meets this isolating function due to safety rules automatically.

However, in most cases in power electronics it is not possible to isolate a measured object (inverter) from the mains. This solution requires usage of large and expensive isolating transformer whose power is comparable to the power of an inverter. Typical example of such power electronics measurement is demonstrated in *Fig.2* when we measure voltage on the high-side transistor during it´s switching.

Inverter is fed directly from the mains. Isolating transformer is also fed from the mains and supplies used oscilloscope. But this transformer has a stray capacitance C_P between

primary and secondary winding. That´s why a capacitive current flows through the probe screening when the transistor is switching. High value of this parasitic current i_P causes high resistive and inductive voltage drops on the screening conductor, which can totally depreciate measured signal.

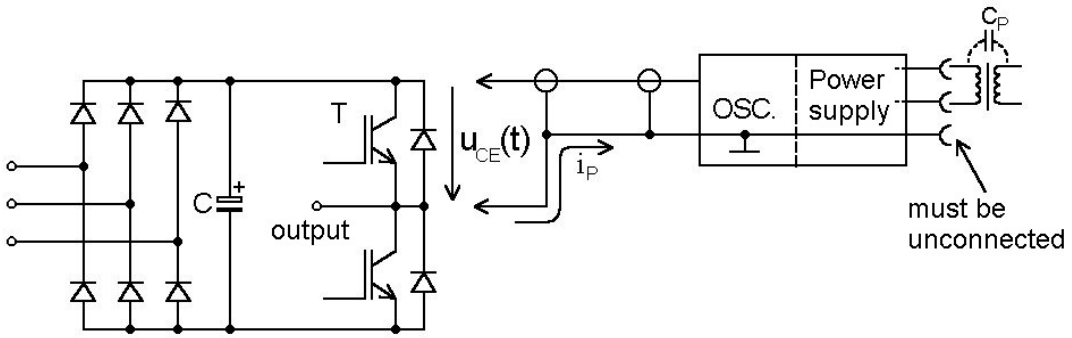

Fig. 2: *Example of power electronics measurement*

2 SELECTED SOLUTION

The main objective is to ensure C_P value as low as possible. This is not performable using mains isolating transformer. On that account, the best way is to use feeding from the battery. That´s why the battery power supply for high performance oscilloscopes (which are not this way equipped) was designed and realized. This power supply represents simple and low-cost solution for oscilloscopes their input side complies with *Fig.3*:

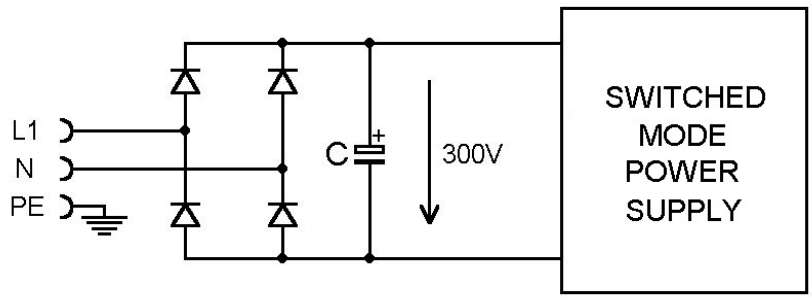

Fig. 3: *Input side of an oscilloscope*

Input terminals L1, N could be directly connected to the 300V DC output of the battery power supply shown in *Fig.4*. That´s a great advantage. There is no more need to design and construct complicated power supply with the sine wave output voltage .

3 CIRCUIT DESIGN

Wiring diagram of power supply based on the flyback DC/DC converter, including control circuitry is in *Fig.4*. System works with constant switching frequency. Low loss current sensing is provided by current transformer Tr_2. Switching transistor is N – channel power MOSFET with low $R_{DS(ON)}$ which has these parameters: 55V, 40/64A, 16mΩ, TO220.

When working in nominal output power, no additional cooling is required. Output rectifier is ultrafast , 1000V, 1A, t_{rr} = 75ns.

Featured battery power supply parameters:

- Input votage range: U_{IN} = 9 -14V
- Output voltage: U_0 = 300V
- Rated output power: P_O = 15W
- Switching frequency: f = 100kHz
- Maximum flux density: B_{max} = 0,3T
- Ferrite transformer core area: S_{Fe} = 0,5cm^2

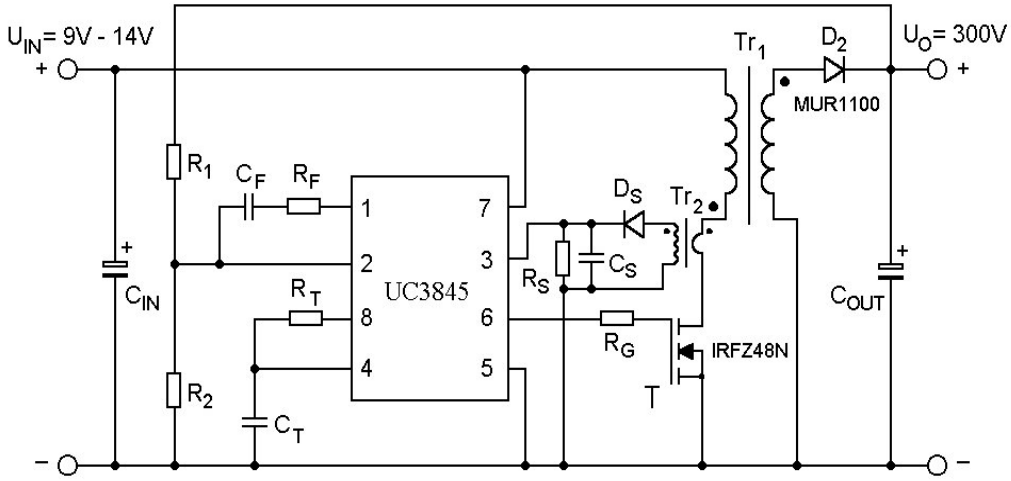

Fig. 4: *Wiring diagram of a converter*

4 CONCLUSION

One of the main requirements was to achieve high efficiency of this battery power supply for the best utiliztion of used battery. Efficiency about 85% was achieved. As a suitable battery types appear sealed lead acid batteries used e.g. in UPS systems, with the capacity higher then cca 2Ah (depending on required working time for one battery charge). When fed from the 12V/5Ah battery an oscilloscope Tektronix TDS1002 can work for the time of approximately 4 hours.

This designed and realized battery power supply for oscilloscope will be an useful instrument to laboratories of power electronics for education and research.

REFERENCES

[1] Datasheet and application notes of UC3845, Unitrode Corporation, http://www.ti.com.

[2] Novotný V., Vorel P., Patočka M. : Napájení elektronických zařízení. Elektronický učební text REL013.