УДК 54.084

Kobets, T.S.,
Master of pedagogical sciences, senior lecturer,
Natural-mathematical Faculty
KSPI, Kostanay, Kazakhstan
Burak, D.V.,
4th course student of speciality «5B011200-Chemistry, Natural-mathematical Facul,
KSPI, Kostanay, Kazakhstan

DEVELOPMENT OF LABORATORY POWER SUPPLY UNIT WITH REGULATED PARAMETERS BASED ON THE LM317TVOLTAGE STABILIZER

Abstract

In this article, the assembly scheme and the results of testing a laboratory power supply based on the LM317T voltage regulator are proposed.The power unit was assembled in the laboratory №813 of the Department of Natural Sciences of the Kostanay State Pedagogical Institute.Explanations of the purpose of each component of the circuit are given for the possibility of reproducing this unit. Technical characteristics are given. The possibility of improving the device by replacing certain radio components with more powerful ones is shown. Didactic materials on the use of this power supply unit are presented in the laboratory practical work on physical chemistry.

Keywords: *power supply, direct current, laboratory equipment, laboratory practice, electrochemistry, physical chemistry*

1. INTRODUCTION

Not all devices in the laboratory operate from the network in 220 volts AC. Many devices (coolers, LED lamps and stands based on them) and chemical processes (electrolysis, electroformming) require a directcurrent for power supply. At the same time, consumption is very different depending on the device or process. For example, to power the LEDs, this may be needed 3.3V to 12V DC. In this connection, there is a need for power supplies with adjustable parameters.

When choosing the type of power supply – pulse or transformer – it needs to clearly understand the advantages and disadvantages. Pulse is much more practical, smaller, more powerful. However, it causes jumps in the output voltage. Transformer is more cumbersome, slightly different in power. But, it produces a constant voltage at the output of the circuit without jumps [1].

In comparison with the linear regulator, the switching power supply has several advantages:

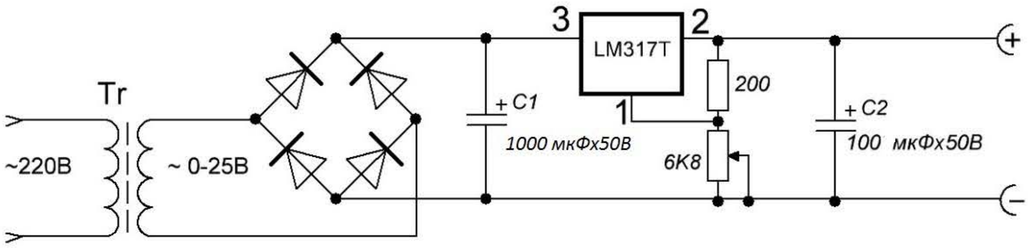
- High efficiency, especially when working in a wide range of input voltages.
- Small size and weight (high specific power).
- The principle possibility of galvanic isolation of input and output circuits. When working from an industrial AC power network, it is not necessary to use a transformer with a large size and weight, calculated for a frequency of 50/60 Hz.

Disadvantages:

- The presence of impulse noise – both differential (antiphase) and common noise (in-phase interference).
- Higher instability of the output voltage when the input voltage or load current changes.
- Longer transients (longer recovery time after a sudden change in input voltage or load current).
- Input negative differential resistance – the input current increases with decreasing input voltage. If the impedance of the primary voltage source (including the input auxiliary circuits of the impulse converter itself) is higher than the negative impedance of the pulse converter, self-oscillations occur with a malfunction and possible damage to the converter.

2. MATERIALS AND METHODS

The circuit of the power unit (Picture 1) works on the voltage regulator LM317T [2].



Picture 1- Power supply circuit diagram

Tr – transformer lowering. The voltage threshold for the voltage regulator is LM317T36 volts, hence the maximum output voltage of the transformer should not exceed this value. But it is possible to use transformers with lower values of the output voltage, for example 24 or 12 volts.

A diode bridge is connected to the terminals of the secondary winding of the transformer. It serves to convert AC to DC.

C1 – The capacitor is installed to rectify the voltage and prevents jumps. In this circuit, a capacitor of 50V and 1000 uF is installed.

LM317T – voltage regulator. Has protection against short circuit and overheating. But in order to increase the service life, it is recommended to screw it to the radiator. On the diagram: 1 - Input, 2 - Output, 3 -Adjust - voltage monitoring.

200 – a constant resistor of 200 ohms. Protects the variable resistor from burnout.

6K8 – The variable resistor performs the function of adjusting the output voltage. The minimum allowable value is 6.8 Ohm, the maximum – up to 10 Ohm.

C2 – capacitor. Just like the first one, it serves to straighten the tension. However, it has a lower nominal value of 50 V 100 μF.

The assembly of the circuit was carried out by hinged installation, but it is also possible to place all the radio components on the board. After that, the whole structure was first placed in the housing from the nonworking ionomer (material, presumably steel), then transferred to a casing made of PVC.

3. RESULTS

After assembly, the power supply was tested using a UT33C multimeter. The measurement data are presented in table 1:

Table 1 – Parameters of the power supply

№	Characteristic	Minimum value	Maximum value	Note
1	Dimensions	100*100*50	250*120*70	The account is conducted on the body
2	Weight	0,2kg	0,8kg	Depending on the material of the case. The weight of the circuit itself is 0.17
3	Input voltage	220V	230V	Errors in the electrical network are not taken into account
4	Output voltage	0,2 V	14 V	The transformer was used for 16 volts, 2 volts – losses when passing through the diode bridge
5	Output current	750 mA	1 A	
6	Adjustment step		0,1 V	

4. DISCUSSION

There is the possibility of an upgrade (improvement). Replace LM317T with LM318. this makes it possible to connect a transformer up to 40 volts with a current strength of up to 5 A. Also in the circuit you can turn on an ammeter and a voltmeter. Connect the USB input to charge the batteries.

5. CONCLUSIONS

The laboratory power supply was successfully introduced into the educational process. It is a part of equipment of the laboratory work by theme «Salts` electrolysis» [3]. The following are excerpts from this laboratory work.

Experiment 1. Electrolysis of the copper (II) sulfate solution.

The graphite electrodes must be gently scraped with emery paper, rinsed with distilled water, dried with filter paper, lowered into a beaker with a prepared copper sulfate $CuSO_4$ solution. The power supply should be connected in the following way: the anode is connected to the red terminal of the power supply unit, the cathode to the black one. Wires are recommended to use the same colors as the terminals. In parallel to the electrodes, a voltmeter is connected, and an ammeter is placed in series after the anode. The power supply is turned on only after the entire circuit is assembled. The current and the time of electrolysis are set by the teacher. Students adjust the parameters by rotating the handle of the variable resistor. When the time has elapsed, the power is turned off. After disconnecting the installation, the electrodes must be removed, dried with filter paper.

Similarly, electrolysis of a sodium sulfate solution and electrolysis with a soluble anode (copper plates several millimeters thick are used as electrodes) are carried out.

References

1. Mack R. Demystifying Switching Power Supplies/1st Edition. – Oxford: Newnes, 2005. – 344 p.
2. Шрайбер Г. 300 схем источников питания: Выпрямители, импульсные источники питания, линейные стабилизаторы и преобразователи/Пер. с франц. – М.: ДМК, – 2000. – 205 с.
3. Кудрявцева О. Техническая гальванопластика. СПб: Изд-во «Политехника», 2011. – издание 6-е, выпуск 2. – 487 с.

Article received by the editorial office: 23.12.2017

КОБЕЦ, Т.С., БУРАК, Д.В.

LM317T КЕРНЕУ СТАБИЛИЗАТОРЫНЫҢ НЕГІЗІНДЕ РЕТТЕЛЕТІН ПАРАМЕТРЛЕРІМЕН ЖАСАҚТАЛҒАН ҚУАТ КӨЗІН ДАЯРЛАУ

Бұл мақалада LM317T кернеу стабилизаторының негізінде жасалған қуат көзін жинау және оның жұмыс істеуін тестілеу нәтижелері ұсынылған. Қуат көзі Қостанай мемлекеттік педагогикалық институтындағы жаратылыстану ғылымдары кафедрасының 813-лабораториясында жиналған. Құрылғыны іске қосу үшін қажетті әрбір тізбек компоненттері туралы ақпарат берілген. Олардың техникалық сипаттамалары жазылған. Кейбір радиокомпоненттерді одан да күшті компоненттерге ауыстыру арқылы құрылғыны жақсарту мүмкіндігі айтылған. Физикалық химия пәнінің лабораториялық практикумында осы жасанды қуат көзін қолдану туралы дидактикалық материалдар көрсетілген.

Мақаланың мәнін ашатын сөздер: *қуат блогы, тікелей ток, зертханалық жабдықтар, зертханалық тәжірибе, электрохимия, физикалық химия.*

КОБЕЦ, Т.С., БУРАК, Д.В.

РАЗРАБОТКА БЛОКА ПИТАНИЯ С РЕГУЛИРУЕМЫМИ ПАРАМЕТРАМИ НА БАЗЕ СТАБИЛИЗАТОРА НАПРЯЖЕНИЯ LM317T

В данной статье предложена схема сборки и результаты тестирования лабораторного блока питания на базе стабилизатора напряжения LM317T. Блок питания собран в лаборатории 813 кафедры естественных наук Костанайского государственного педагогического института. Для возможности воспроизведения данного блока даны пояснения о назначении каждого компонента цепи. Приведены технические характеристики. Показана возможность улучшения прибора за счёт замены некоторых радиокомпонентов на более мощные. Приведены дидактические материалы по использованию данного блока питания в лабораторном практикуме по физической химии.

Ключевые слова: *блок питания: постоянный ток, лабораторное оборудование, лабораторный практикум, электрохимия, физическая химия.*