

# THE SYSTEM OF CONSTANT CURRENT FOCUS KLYSTRON KIU-37 MASTER PULSED MICROWAVE GENERATOR ELECTRON LINEAR ACCELERATOR

*V.I. Beloglazov, Yu.D. Tur, Yu.A. Titarenko, A.V. Filippov, S.K. Romanovsky  
National Science Center "Kharkov Institute of Physics and Technology", Kharkov, Ukraine*

In order to ensure long-term stability of beam parameters of linear accelerators is working on stabilizing the excitation of high-power systems. At this stage the solution of the problem, developed and applied in practice stabilization focusing coil current klystron KIU-37 to eliminate the dependence of the output power from the mains supply voltage fluctuations and other destabilizing factors. Its use has provided the stability of the output current in the range of  $\pm 0.5\%$  with changes in the supply voltage  $\pm 10\%$ , which, in turn, made it possible to significantly increase the long term stability of parameters of the excitation signal.

PACS: 29.17.+w

## INTRODUCTION

One of the basic requirements of operation of linear electron accelerators is to enhance and ensure the long term stability of parameters of high-frequency systems, the main elements of which are high-voltage modulators, heavy duty amplifier klystrons and excitation system. In particular, excitation systems, high-power linear accelerator LUE 10 [1], EPOS [2], LUE-40m [3] provided two sets of master pulsed microwave generator [4], using the final stage in the klystron KIU-37. At this stage the solution of the problem, developed and applied in practice stabilization focusing coil current klystron KIU-37 to eliminate the dependence of the output power from the mains supply voltage fluctuations and other

destabilizing factors. Klystron focusing coil powered by a direct current adjustable range 2...5 A at voltages up to 160 V. Focusing coil current regulation ensures optimum output klystron of KIU-37. The stability of the output current of the focusing coil is affected by fluctuations in the mains voltage, thermal drift of the resistance of the coil and the other elements of installation and other factors. In the event focusing coil current of more than 3% of the optimal value decreases output power klystron of KIU-37 below the values permitted for normal operation of the accelerator.

## OPERATING PRINCIPLE

Schematic diagram of the device is shown in Fig. 1.

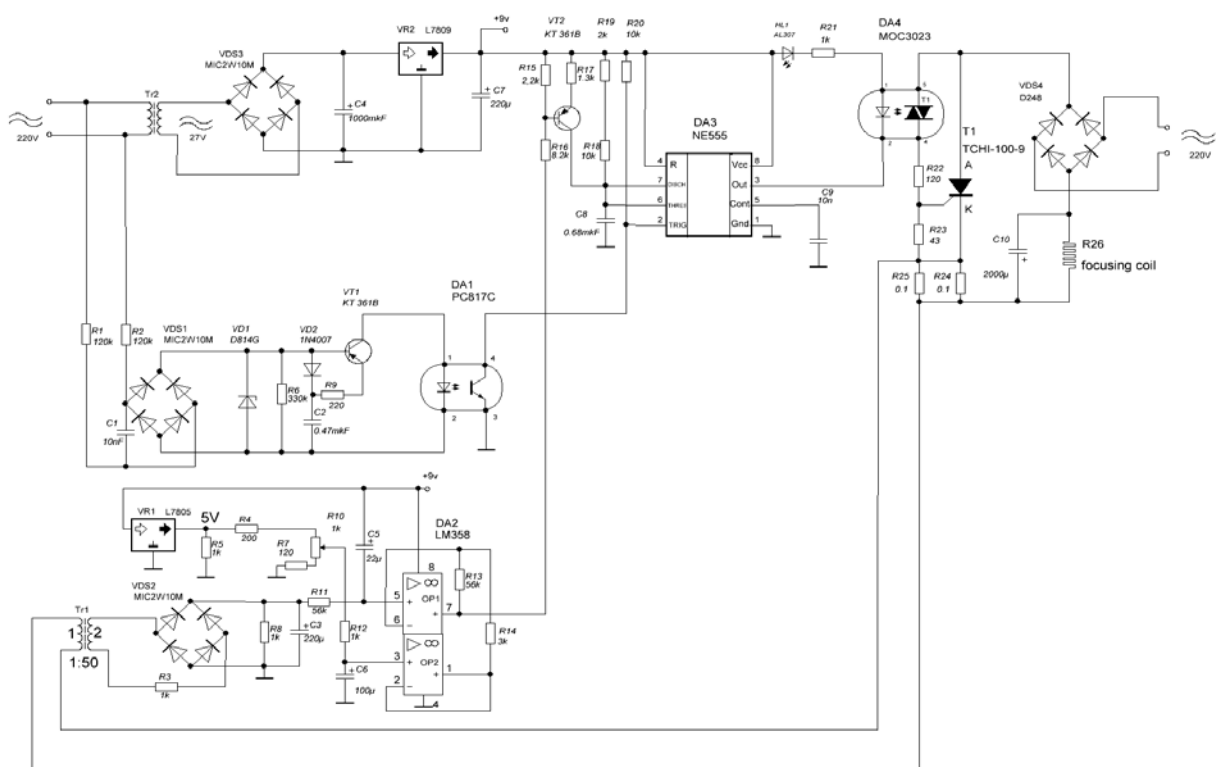


Fig. 1. Schematic diagram

The device is a pulse position thyristor. As a regulatory element such as a thyristor used TCHI-100-9 with the maximum permissible values  $I_{max} = 100$  A at 900 V  $U_{rev}$ . Thyristor firing angle is determined by the one-shot pulse width of waiting on the chip DA3 type NE555, Timing chain which consists of a capacitor C8,

resistors R18, R19 and collector junction transistor VT2, voltage controlled feedback. In the moment of transition of network tension through "0" the impulse of start of a monostable multivibrator is formed by the knot of elements VT1, DA1. The sensor output current is composed of resistors R3, R8, R11, R25, R26,

transformer Tr2, VDS2 bridge rectifier and a capacitor C3 and a linear dependence of the output voltage from the current focusing coil.

The sensor output voltage and the reference voltage from the resistor R10 of the engine, which regulates the output current supplied to an operational amplifier DA2, the difference signal from the output of which is supplied to the base circuit of transistor VT2, which leads to a change in the firing angle of the thyristor and the output current. Through the use of chips with optocouplers DA1 and DA4 and the transformer Tr2 implemented galvanic isolation between circuit elements and the voltage supply.

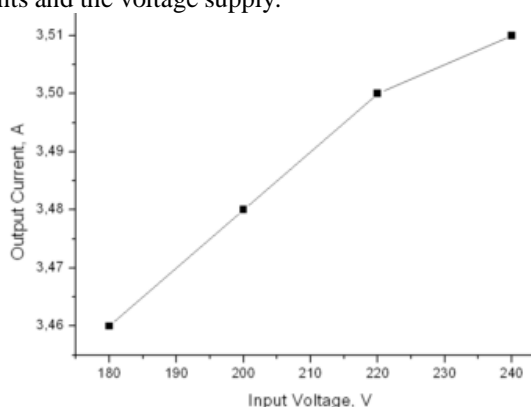


Fig. 2. The dependence of the output current from the input voltage

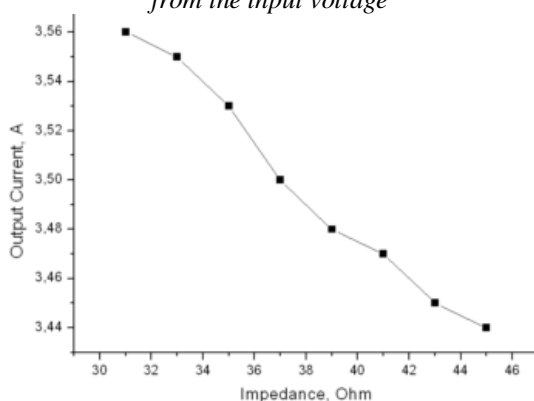


Fig. 3. The dependence of the output current from the load resistance



Fig. 4. Appearance of the assembled board devices

## CONCLUSIONS

The developed system of stabilization focusing coil current of klystron KIU-37 is mounted on the master pulsed microwave generator. Its use has provided the stability of the output current in the range of  $\pm 0.5\%$  with changes in supply voltage  $\pm 10\%$ , significantly improve the long-term stability of the parameters of the drive signal (Figs. 2, 3).

The system is mounted on the master pulsed microwave generator and allowed to eliminate fluctuations in the power output of the klystron KIU-37 when you change the focusing coil current (Fig.4).

## REFERENCES

1. V.I. Beloglazov, A.I. Zykov, E.S. Zlunitsyn, et al. An electron linac producing beam power up to 15 kW // *Proc. of the 1996 EPAC*. 1996, v. 1, p. 798-800.
2. Yu.D. Tur. Linear Electron Accelerator for Isotopes Production // *Proc. of the 2000 EPAC*. 2000, p. 2560-2562.
3. V.M. Grishko, I.A. Grachev, G.L. Fursov, et al. The linear accelerator at an average current of 1 mA // *Nuclear Tehnica*. 1979, v. 46, v. 5, p. 336-340.
4. Pulse microwave generator "Kremen" / *Technical description and user ekspluatatsii*. 1973, Leningrad.

Article received 22.10.2015

## СИСТЕМА СТАБИЛИЗАЦИИ ТОКА ФОКУСИРОВКИ КЛИСТРОНА КИУ-37 ЗАДАЮЩЕГО ИМПУЛЬСНОГО СВЧ-ГЕНЕРАТОРА ЛИНЕЙНОГО УСКОРИТЕЛЯ ЭЛЕКТРОНОВ

*В.И. Белоглазов, Ю.Д. Тур, Ю.А. Титаренко, А.В. Филиппов, С.К. Романовский*

С целью обеспечения долговременной стабильности параметров пучков линейных ускорителей проводятся работы по стабилизации возбуждения систем высокочастотного питания. На этом этапе решения поставленной задачи разработана и применена на практике система стабилизации тока фокусирующей катушки клистрона КИУ-37 с целью устранения зависимости выходной мощности от колебаний напряжения питающей сети и других дестабилизирующих факторов. Ее использование обеспечило стабильность выходного тока в пределах  $\pm 0,5\%$  при изменениях напряжения питающей сети  $\pm 10\%$ .

## СИСТЕМА СТАБІЛІЗАЦІЇ СТРУМУ ФОКУСУВАННЯ КЛІСТРОНА КИУ-37 ЗАДАЮЧОГО ІМПУЛЬСНОГО НВЧ-ГЕНЕРАТОРА ЛІНІЙНОГО ПРИСКОРЮВАЧА ЕЛЕКТРОНІВ

*В.І. Белоглазов, Ю.Д. Тур, Ю.А. Титаренко, А.В. Філіппов, С.К. Романовський*

З метою забезпечення довготривалої стабільності параметрів пучків лінійних прискорювачів проводяться роботи по стабілізації збудження систем високочастотного живлення. На цьому етапі рішення поставленої задачі, розроблена і застосована на практиці система стабілізації струму фокусувальної котушки клистрона КИУ-37 з метою усунення залежності вихідної потужності від коливань напруги живлячої мережі і інших дестабілізуючих чинників. Її використання забезпечило стабільність вихідного струму в межах  $\pm 0,5\%$  при змінах напруги живлячої мережі  $\pm 10\%$ .