

HIGH-VOLTAGE POWER SUPPLY FOR GOG-1001

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Abstract

The submitted report contains the description of the high-current high-voltage quasipulse four-channel laser pumping power supply. Channels are the completely identical. It is possible to feed up to 10 kJ on each channel with up to 5 kA of output current. Source controller is developed with PLM, Atmega MCU and ARM type CPU which allows to optimize operations of device, and also to make a number of calculations. The controllers are connected by internal control network for more flexibility and efficiency. The description of the source and the test results are presented.

INTRODUCTION

At the present stage of development of systems of deduction of high-temperature plasma the question of stability of walls of a vacuum chamber remains very urgent. One of the key problems is firmness of diverter plates during the pulse. The particle fluxes influence on them and energy leading to formation of serious defects, melting and intensive evaporation of material. The studying of these processes demands carrying out dynamic measurements directly during intensive radiation of material. It is for this purpose offered to use the measuring technique of scattering of synchrotron radiation, and for model operation of thermal influence to use a laser radiation [1]. The laser impulse with energy of 1000 J is formed by GOG 1001. This is the optically-excited laser. There are four flashlight gas-discharge valves are used for laser pumping.

The high-voltage quasipulse source which would perform not only function of supply, but also monitoring of lamps status during the pulse. It is necessary for a delivery of system of pump excitation. The source offered below which has the following parameters was developed for these purposes:

- An opportunity to feed at the same time up to four lamps
- Peak energy to 10 kJ on one lamp
- Amplitude of output current to 5 kA.

DESCRIPTION

The block diagram of a source is shown on Fig.1. The source consists of the discharge circuit giving to lamps energy from accumulative capacity and the parallel scheme of ignition of an arch in a lamp [2]. In total 4 channels are executed equally and are started synchronously. Charging of capacity of a discharge circuit is

carried out by the linear charger. The power supply controller allows both manual control from the forward panel of a source and removed from the workstation. The management of charging, with start-up and monitoring of work of a source is also provided.

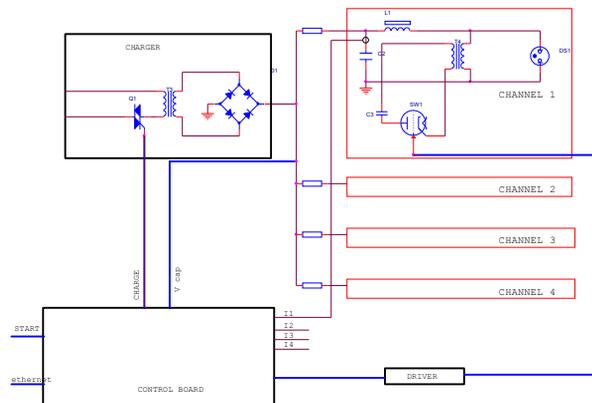


Figure 1: Block diagram of a source.

Charger

The charger represents a step-up transformer with the bridge rectifier and the current-limiting resistor at the output. At achievement by tension on the storage capacitance bank voltage of the assigned level the charging source is disconnected by a TRIAC switch. For compensation of an electrostatic leakage when maintaining the given tension on capacity the switch carries out short-term (on 50 ms) ON-state of the charging source.

Discharge Circuit

The bank of k75-100 750 μ F type capacitors everyone with an operating voltage up to 6 kV are used as the store of energy. Each capacitors connected through the throttle to the load. Switching is carried out by a path of ignition of the electrical discharge in the lamp. The discharge caused by voltage pulse produced with the parallel contour representing a step-up transformer with 3 μ F capacity switching to the primary winding with the thyatron-based switch. The capacitance charged up to the voltage of 3 kV. The low-current small-size high-voltage converter is used for charging of this capacity. Application of the described scheme of start allows changing the energy of flash in very wide limits: beginning from 1% of rated power that favourably distinguishes the described source created for the same purposes before.

Controller

The controller which carries out the following functions was developed for management and monitoring of a source

- Monitoring of tension of charging of capacities of a discharge circuit
- Management of an arson of lamps
- Monitoring of impulse currents
- Manual and remote control by a source
- Protection of a source and laser

The programmable logical matrix responsible for processing of signals of protection and start is the cornerstone of a source. By means of the microprocessor on the basis of the Atmel family realise a feed-back on charging of storage capacity to the necessary level, and also is carried out manual control and a conclusion to information to the graphic touch display.

The microprocessor on the basis of ARM is responsible for communication with a higher control system on ethernet networks, processing of signals of the impulse currents removed by means of Rogovsky's belts established on each capacity and for data processing.

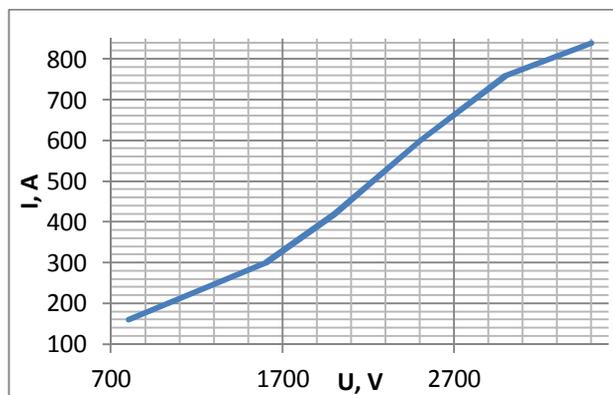


Figure 2: Pumping lamp current vs capacitance bank voltage.

CONCLUSION

The current source was made and fully tested. The Fig.2 presents the dependence of the current proceeding through lamps vs voltage on storage capacitance.

REFERENCES

- [1] A. Arakcheev et al., AIP Conf. Proc. 1771 (2016) 060003 <http://dx.doi.org/>
- [2] I. Volkov, V. Vakulenko "Power supplies of lasers" (in Russian, 1976).