

Golubenko J.I., Kuksanov N.K., Nemytov P.I.

Powerful electron accelerator ELV-12 for ecological applications: power supply and control.



ELV-12 accelerator

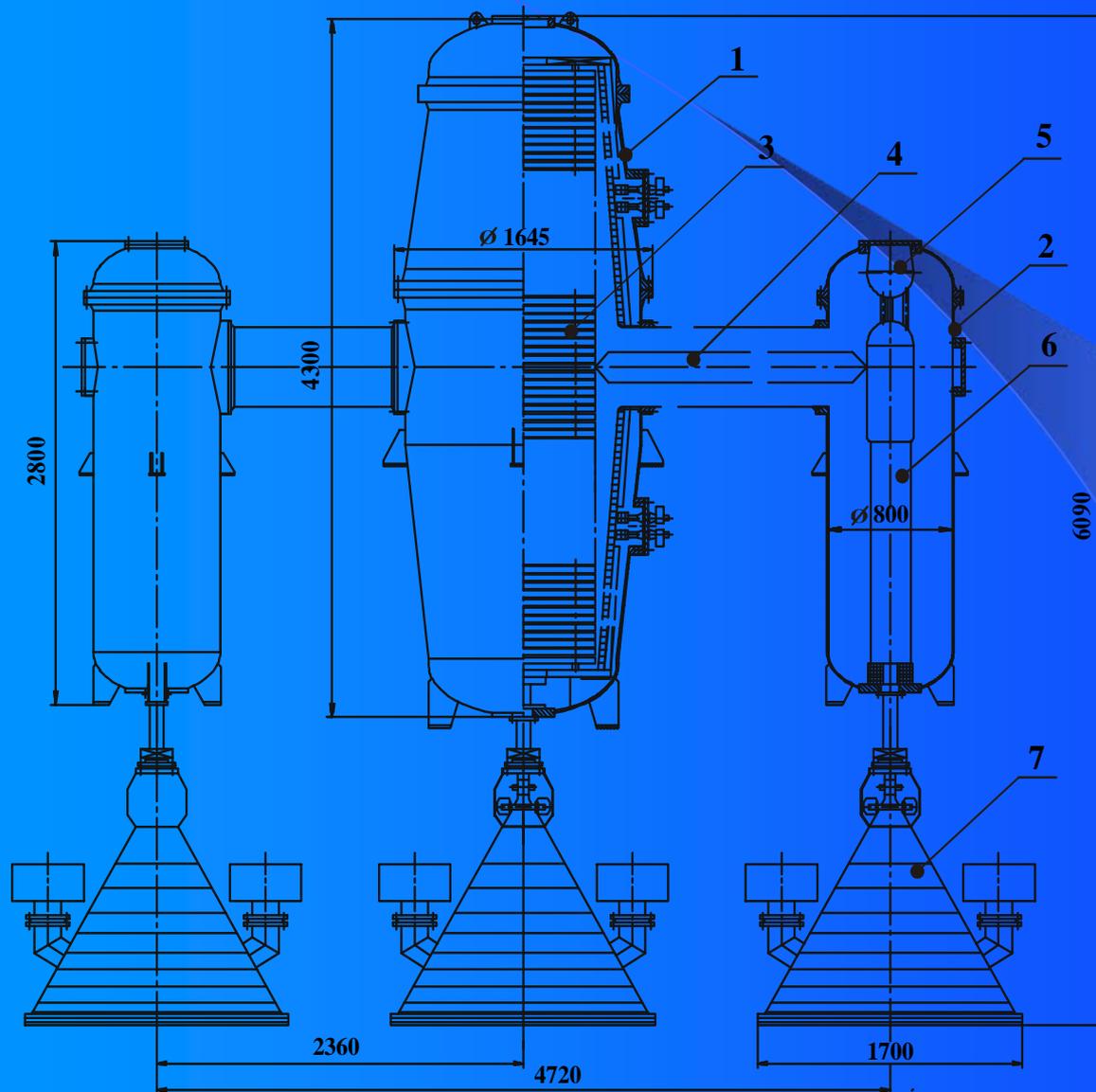
- Beam energy – 0.5...1.0 MeV
- Beam current - 0...0.5 A
- Operates with power of beam – 400 kW
- Testing power – 500 kW
- 3 extraction device and 3 accelerating tube
- Ecological applications
- Clock round operation

Introduction:

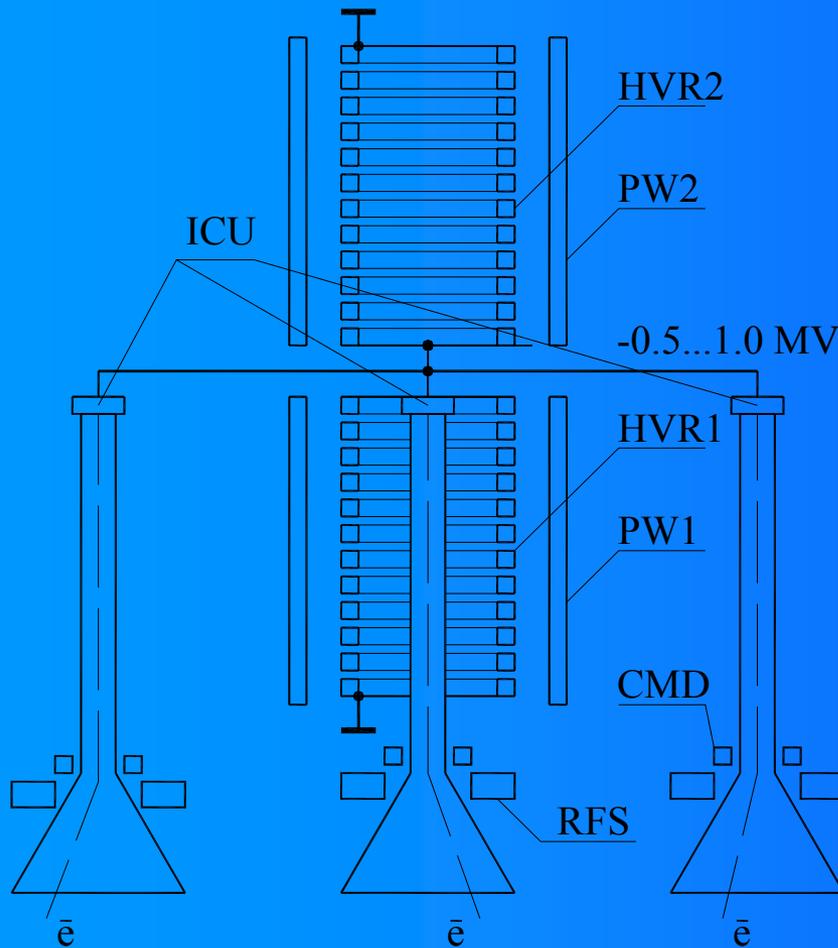
Based on the transistor two-phase frequency converter the power supply system of ELV-12 accelerator with an extracted beam power up to 400...500 kW is discussed. The problems arising at beam extracting into atmosphere through two parallel titan foils are studied. Method of independent centering of beam on the each foil is shown. Methods of independent measurements, stabilization and regulation of beam currents in several accelerating tube fed from one high-voltage source are revised.



ELV-12 accelerator layout.



Functional diagram of accelerator



- PW1, PW2 – primary windings
- HVR1, HVR2 – H/V rectifiers
- RFS – deflecting electromagnets of raster-forming systems
- CMD – beam current meter
- ICU – regulated power sources for heating of electron gun

ELV-12 industrial accelerators



12/1/2001

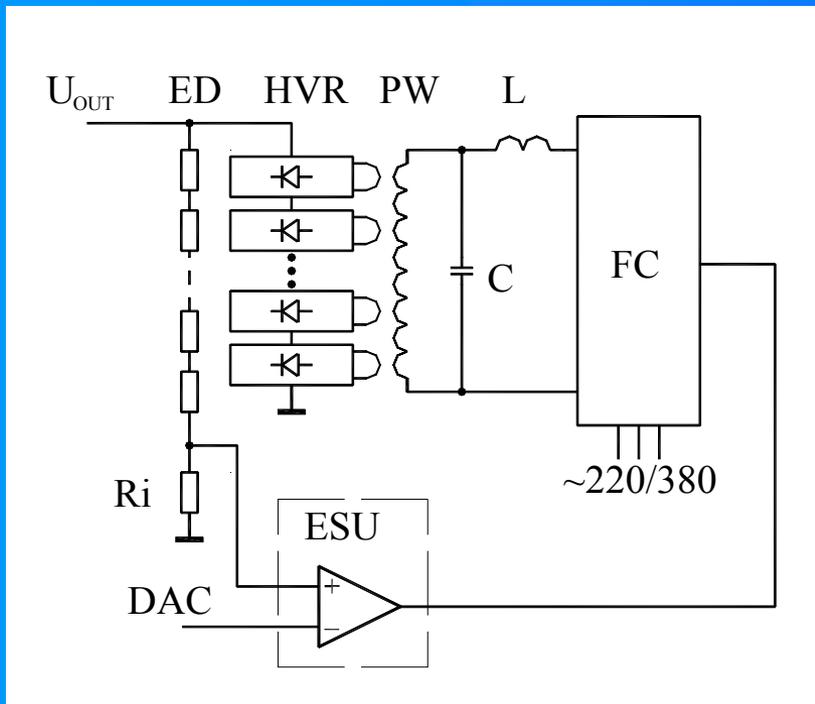
Another view of ELV-12



Main systems

- Frequency converter
- Energy stabilizer
- 3 beam current stabilizers
- Raster formation systems
- Beam shift systems
- Control station: ADC, DAC, IR, OR

ENERGY STABILIZING SYSTEM



- PW – Primary winding
- HVR – HV rectifier
- ED – measuring divided
- ESU – stabilizer unit with
PID-regulator
- FC – frequency converter
- LC – circuit for matching
of impedances



Primary windings

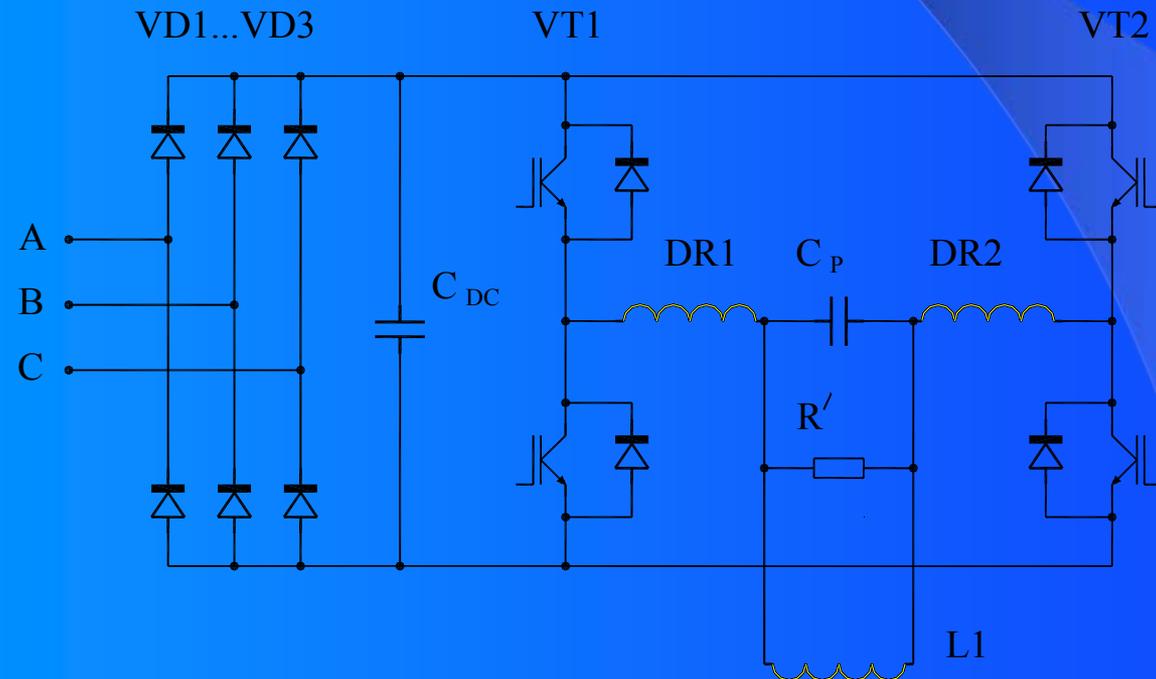


- Maximal voltage – 900 V
- Maximal current – 900 A
- Inductance – 0.24 mH
- 16 turns with water cooling
- Frequency – 640 Hz

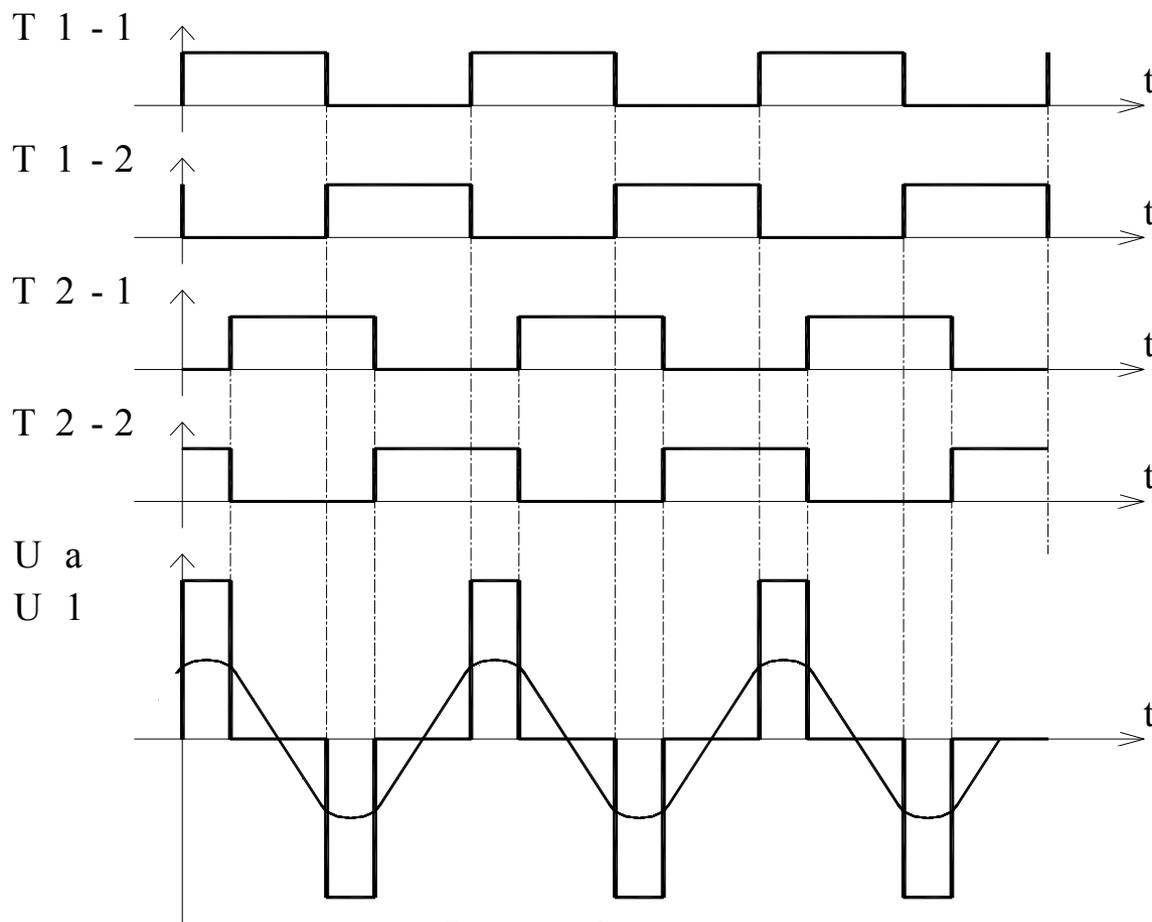
Main Technical parameters of FC

- Voltage of the mains is 380/220 V, 50 or 60 Hz;
- Accelerator beam power is up to 150 kW;
- For increasing beam power up to 500 kW it is necessary to connect 4 this converters in parallel.
- Coefficient of power efficiency - 95%;
- Output frequency of the converter is 400 - 1000 Hz;
- Cooling method is water cooling;
- Type of power transistors - SKiiP-942 GB.
- Range of regulation on the first harmonic of an output voltage of the transistor bridge – 0 ... 400 V.

- Inverter module 150 kW, 400...1000 Hz
- Protections: maximal voltage, maximal current, temperature, connect with ground

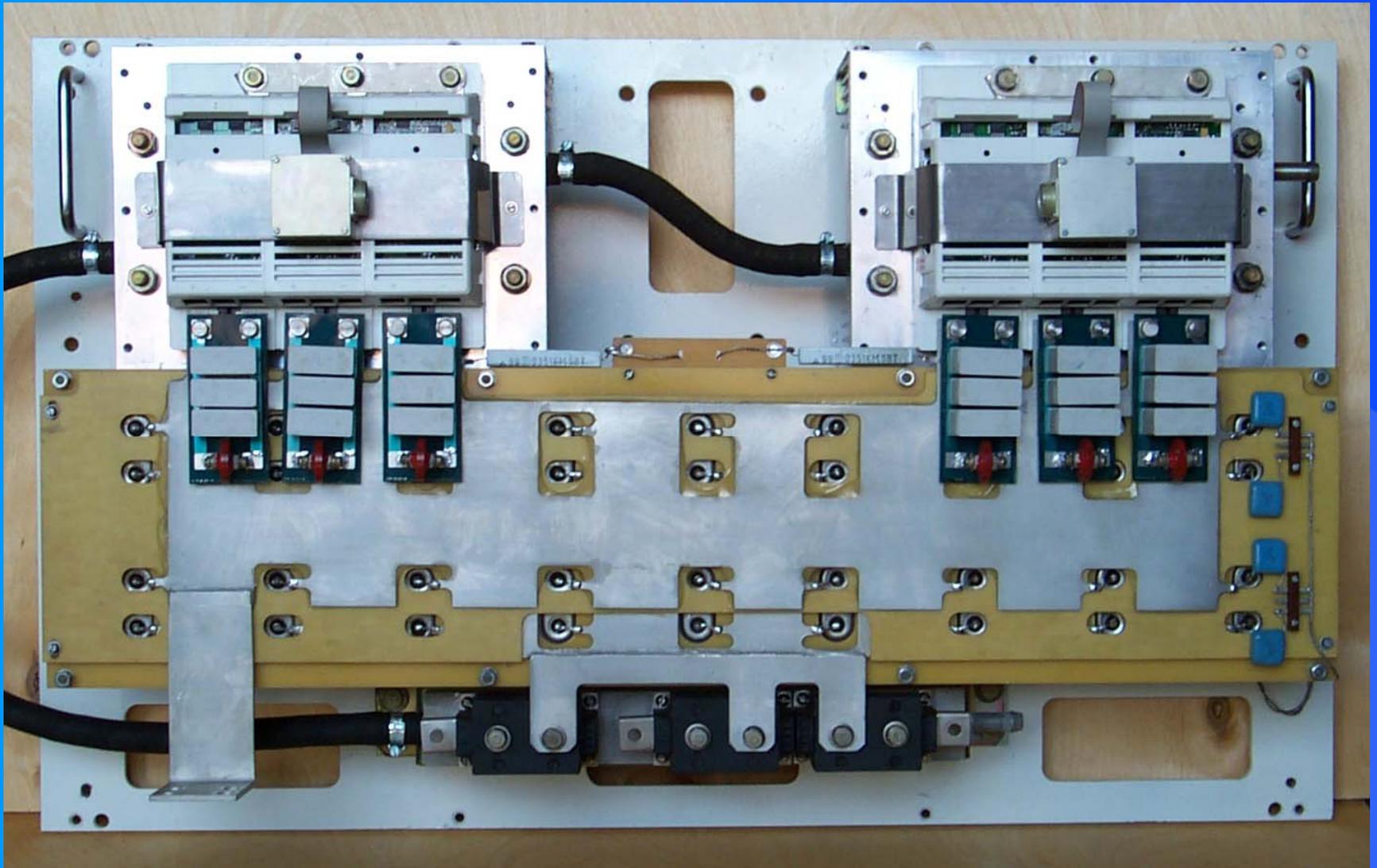


Regulation of output voltage of inverter



Р и с . 2 .

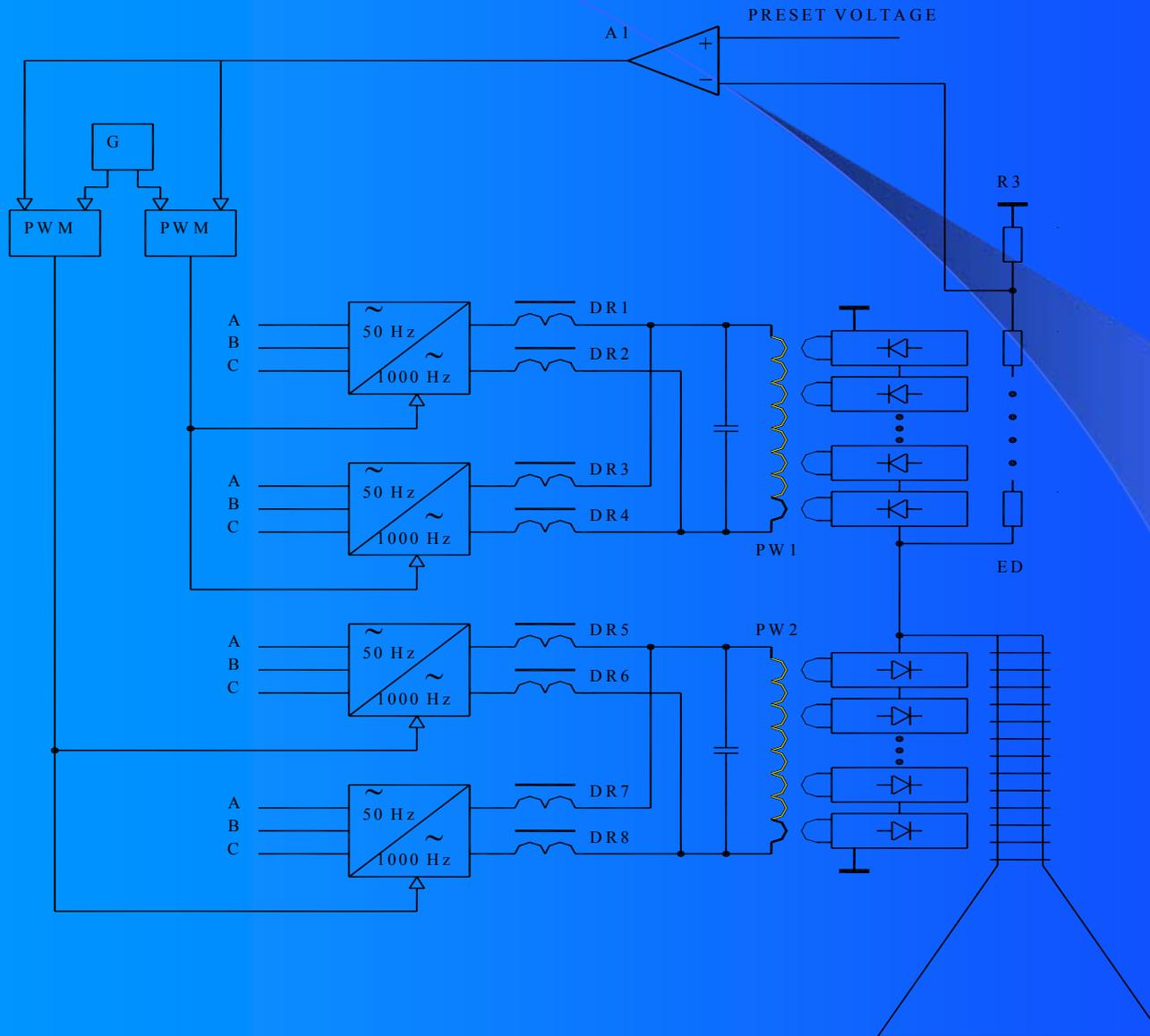
Inverter module



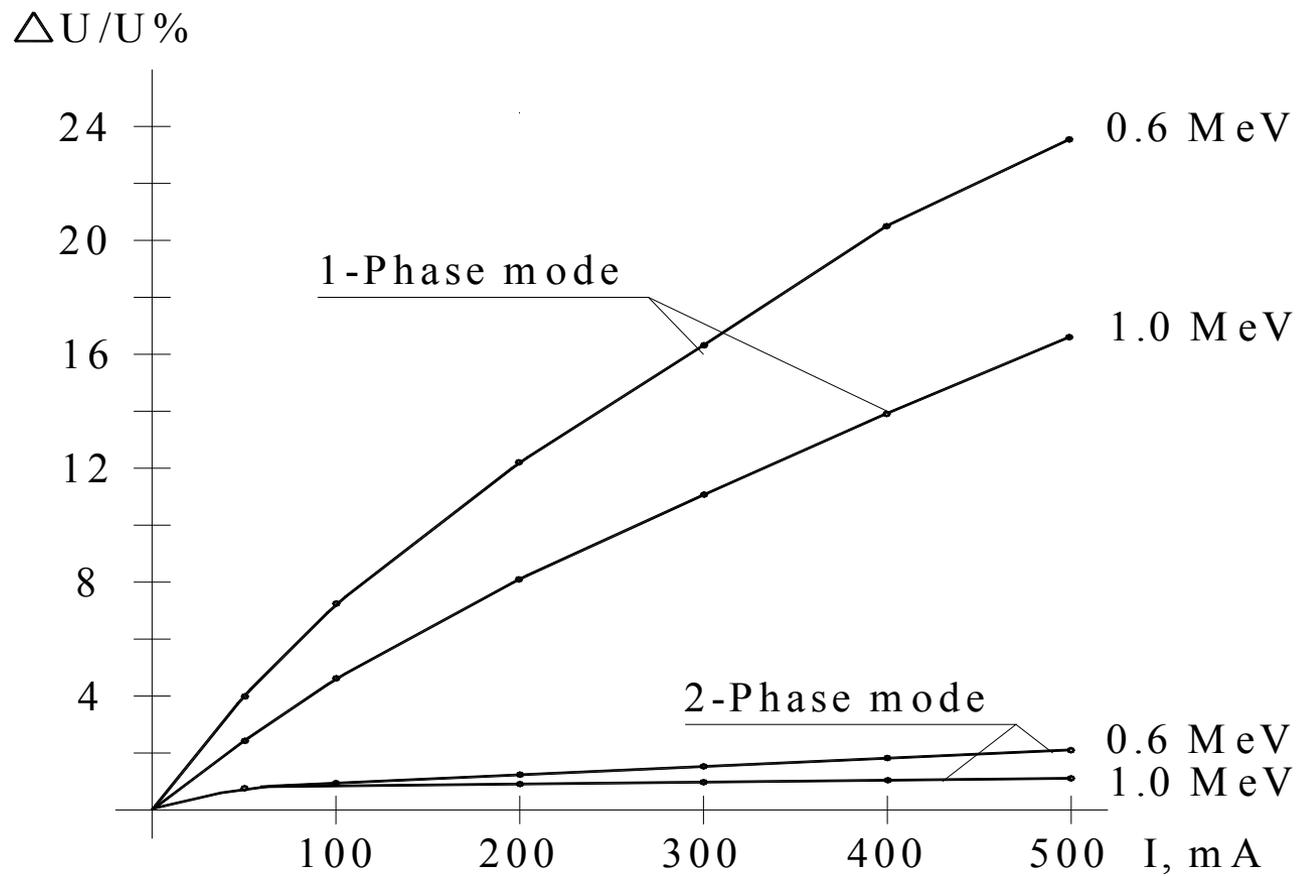
2-phase, 500 kW inverter



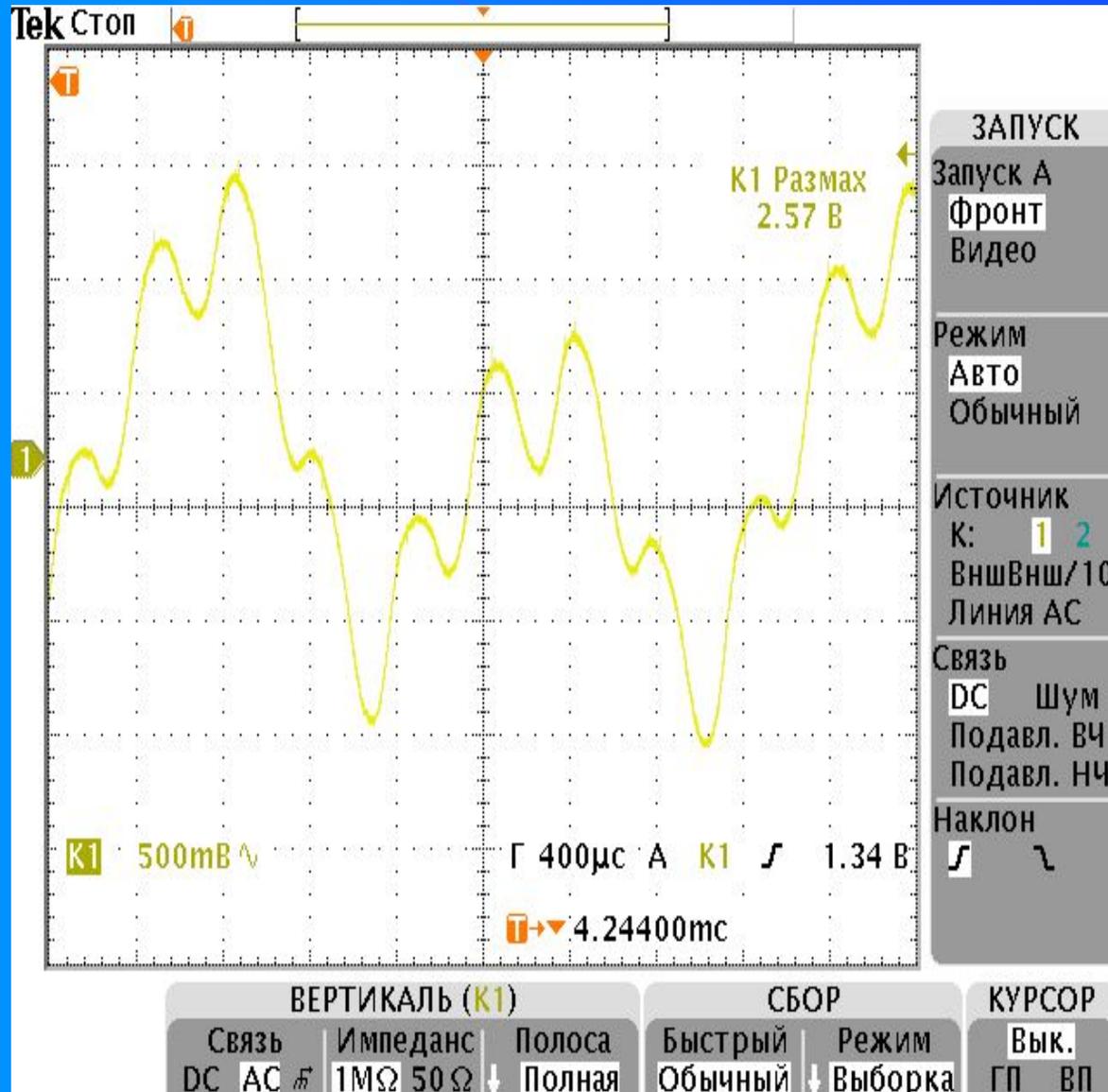
- 2-phase inverter diagram with adding of power from 4 inverter modules



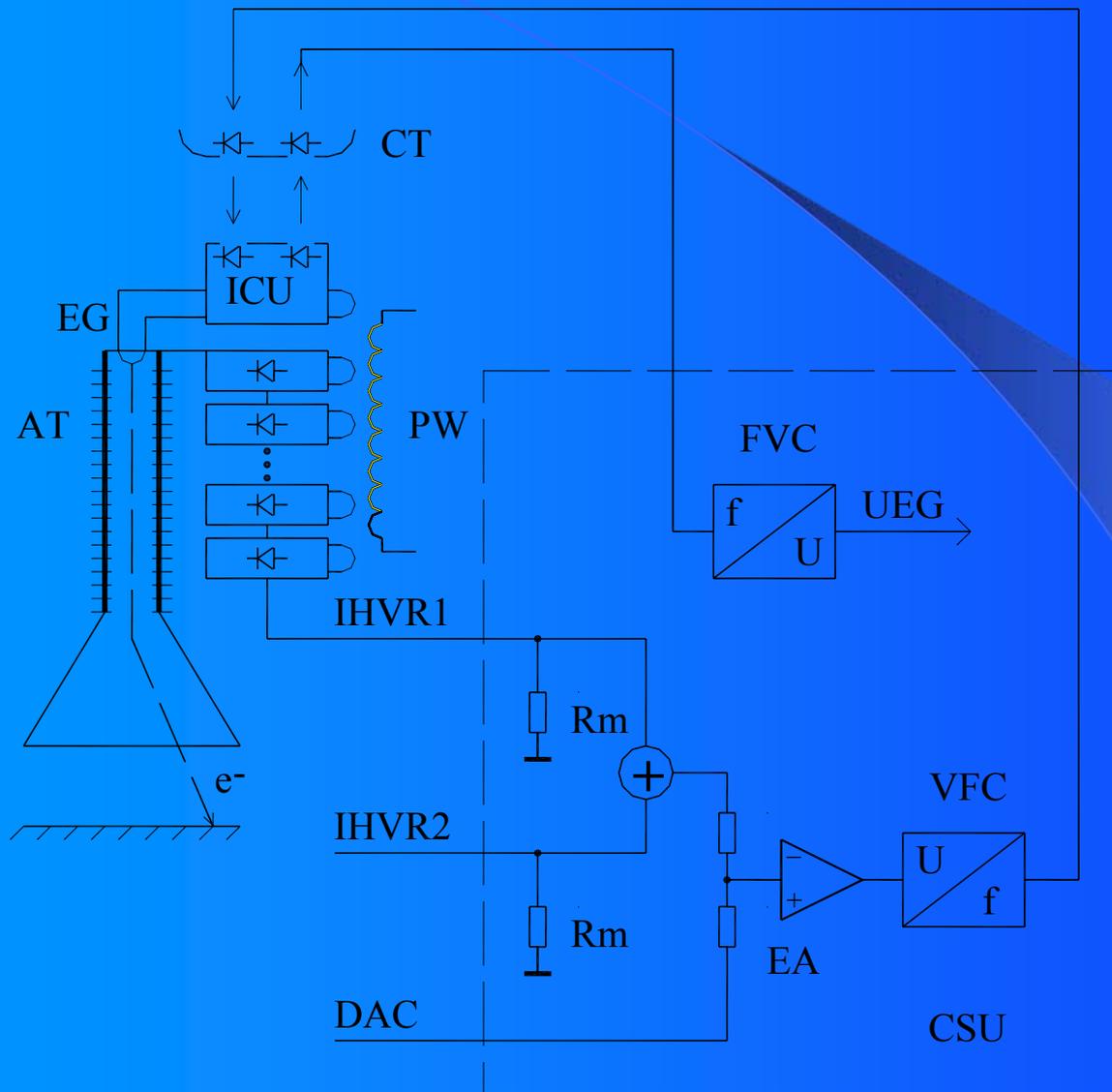
- Rippling of output voltage of HV rectifier.



Rippling of output voltage of HV rectifier

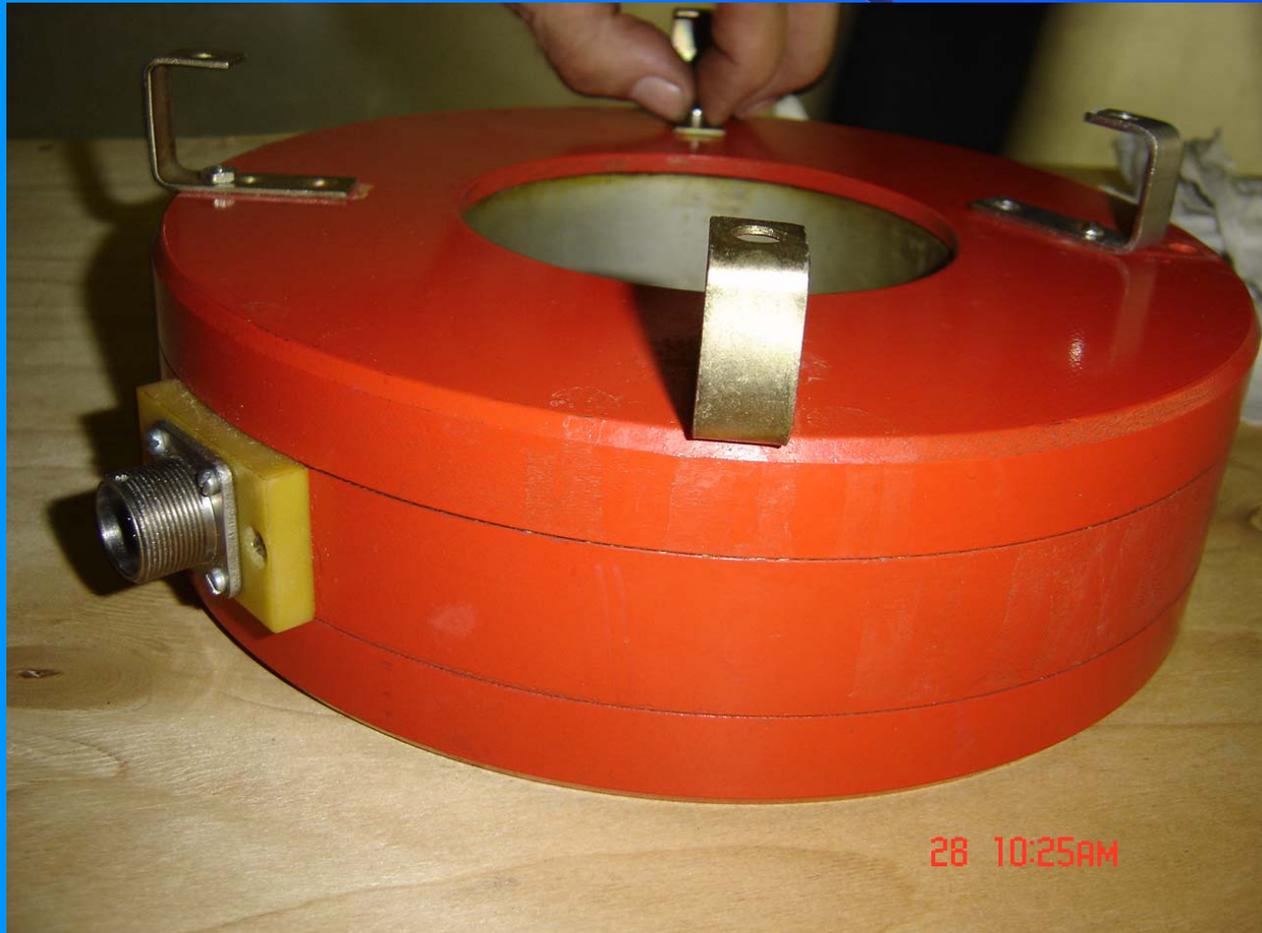


● Current stabilizer

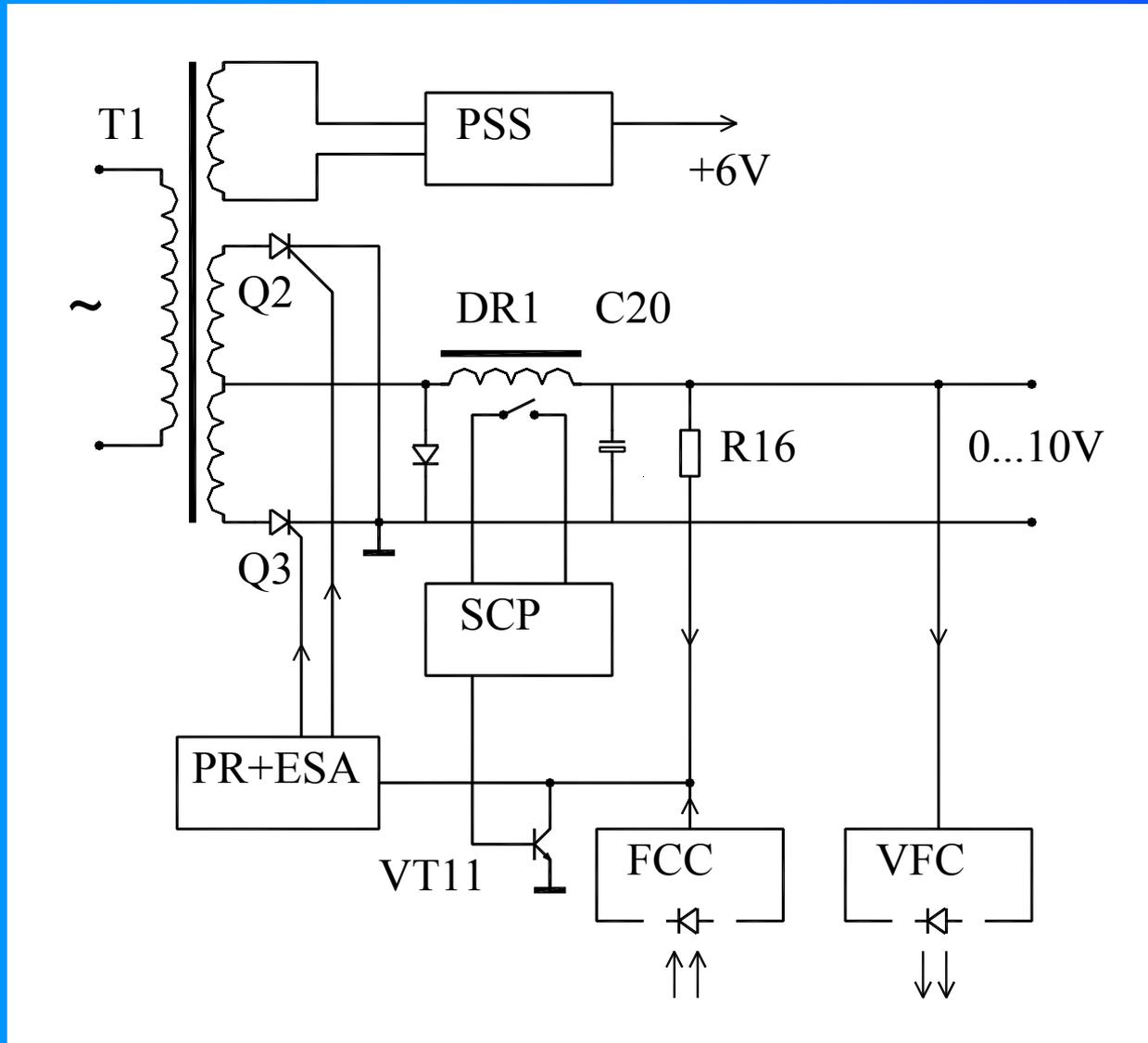


Current measuring device

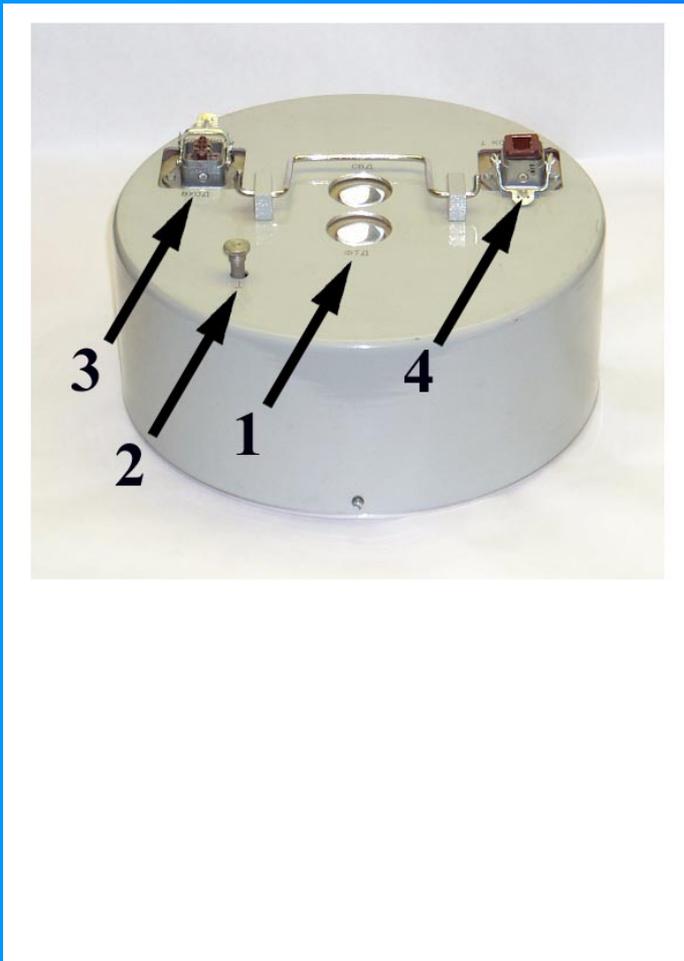
Measure range – 0...250 mA, Accuracy – 1%



- Injector control unit



Injector control unit

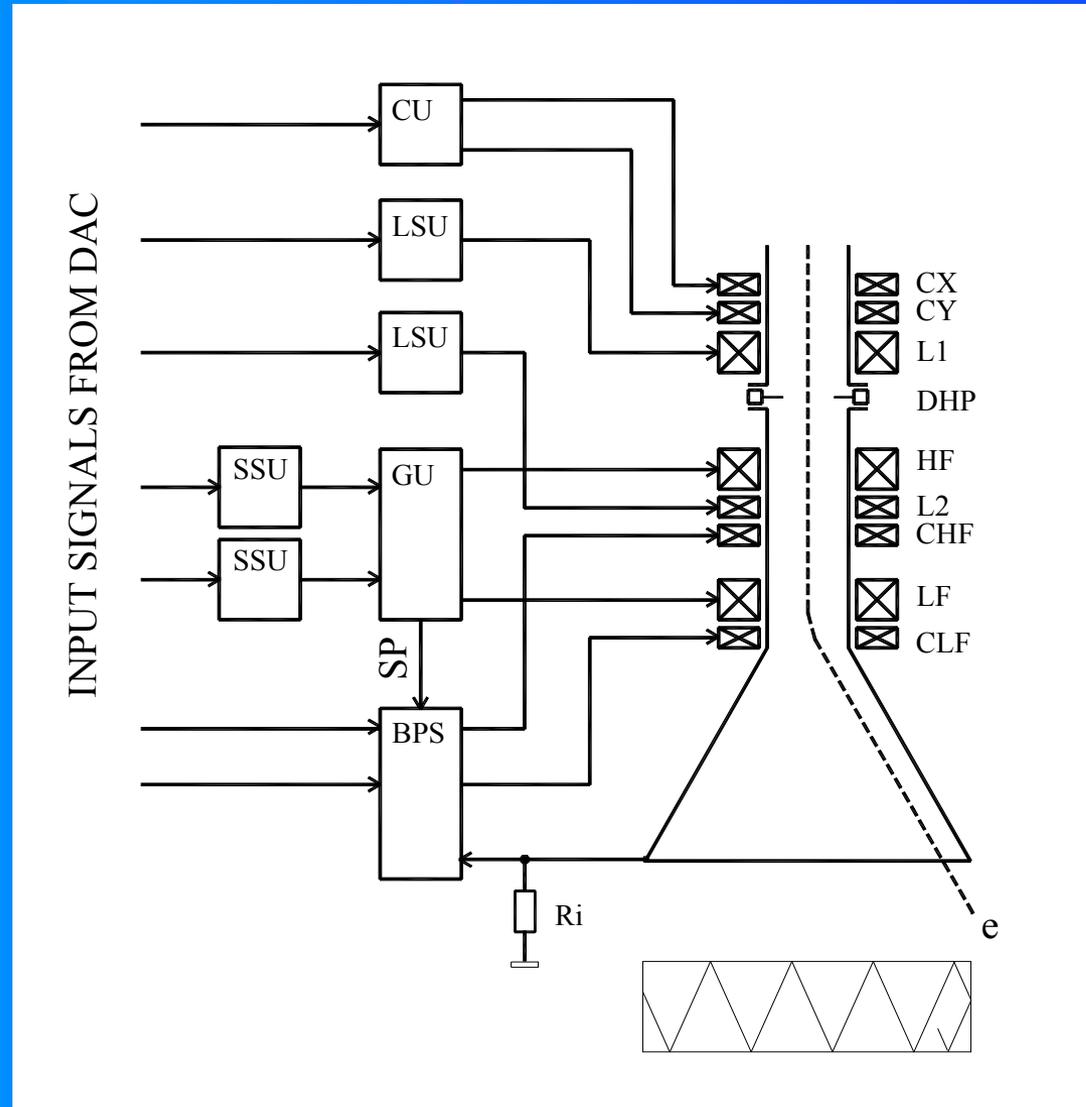


- 1 – Optical system
- Input range – 70...400 V
- Output power – 150 W
- Digital control (U/F conv)

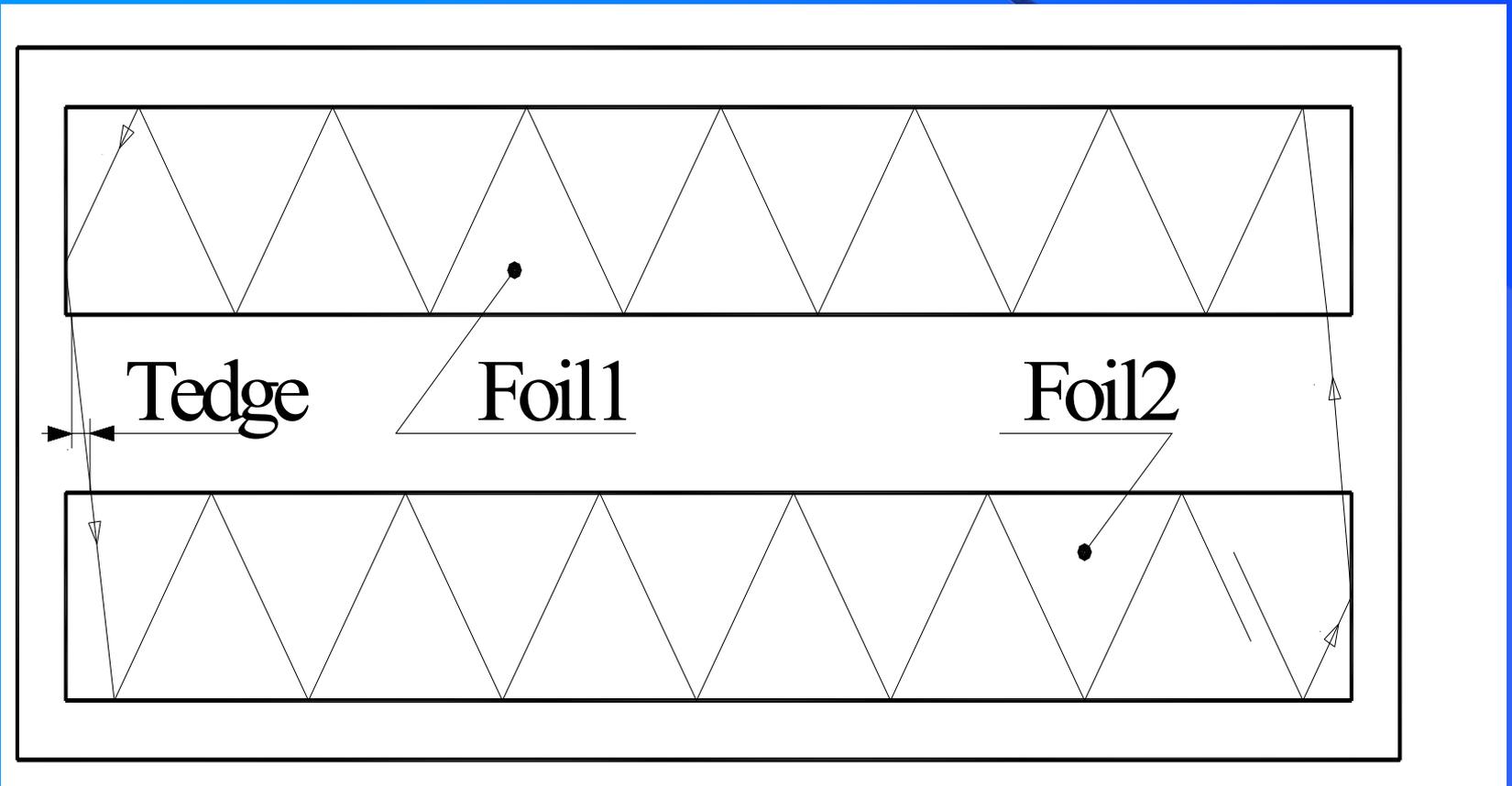
Raster formation system

- 3 – extraction devices
- 2 – parallel titanium foil for each device
- LF and HF scanner coils
- Correction coils
- Lenz
- Beam shift units

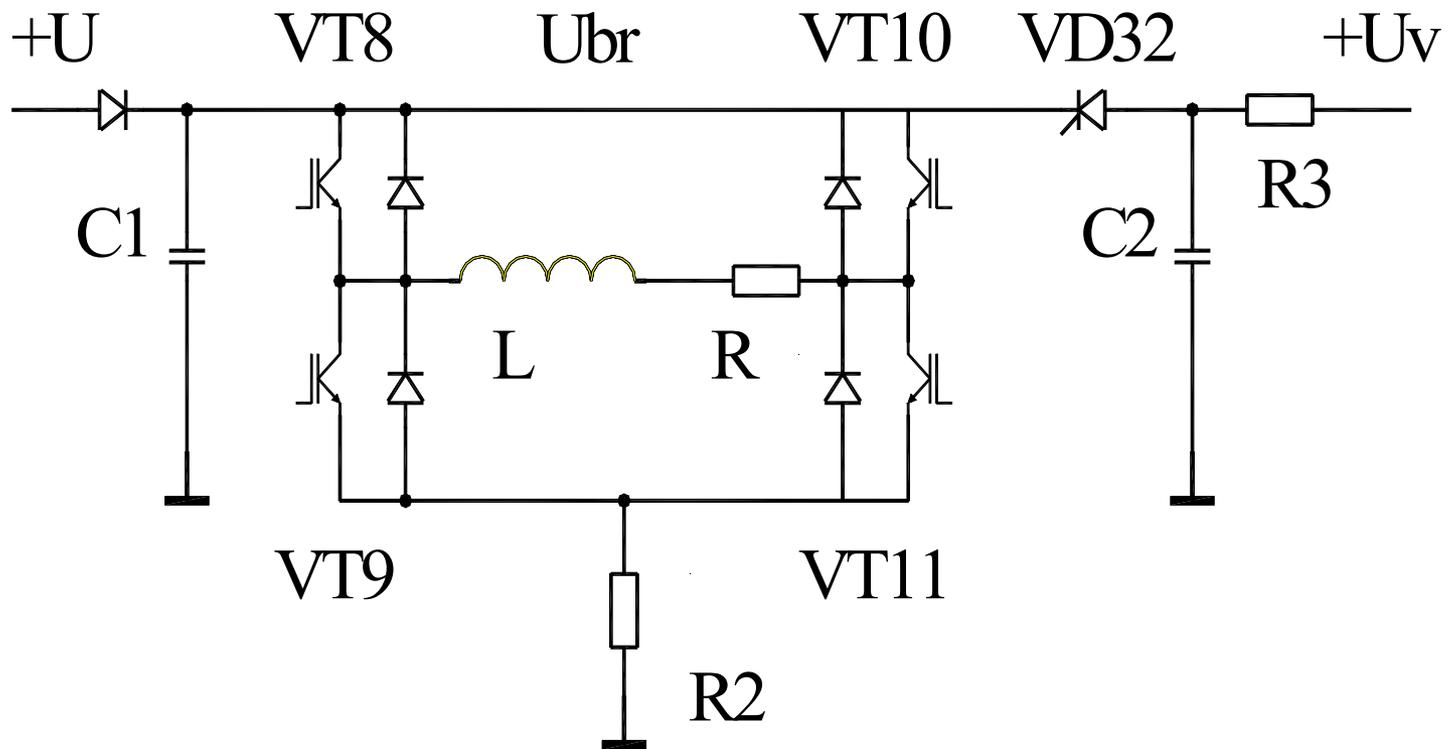
● Raster formation system



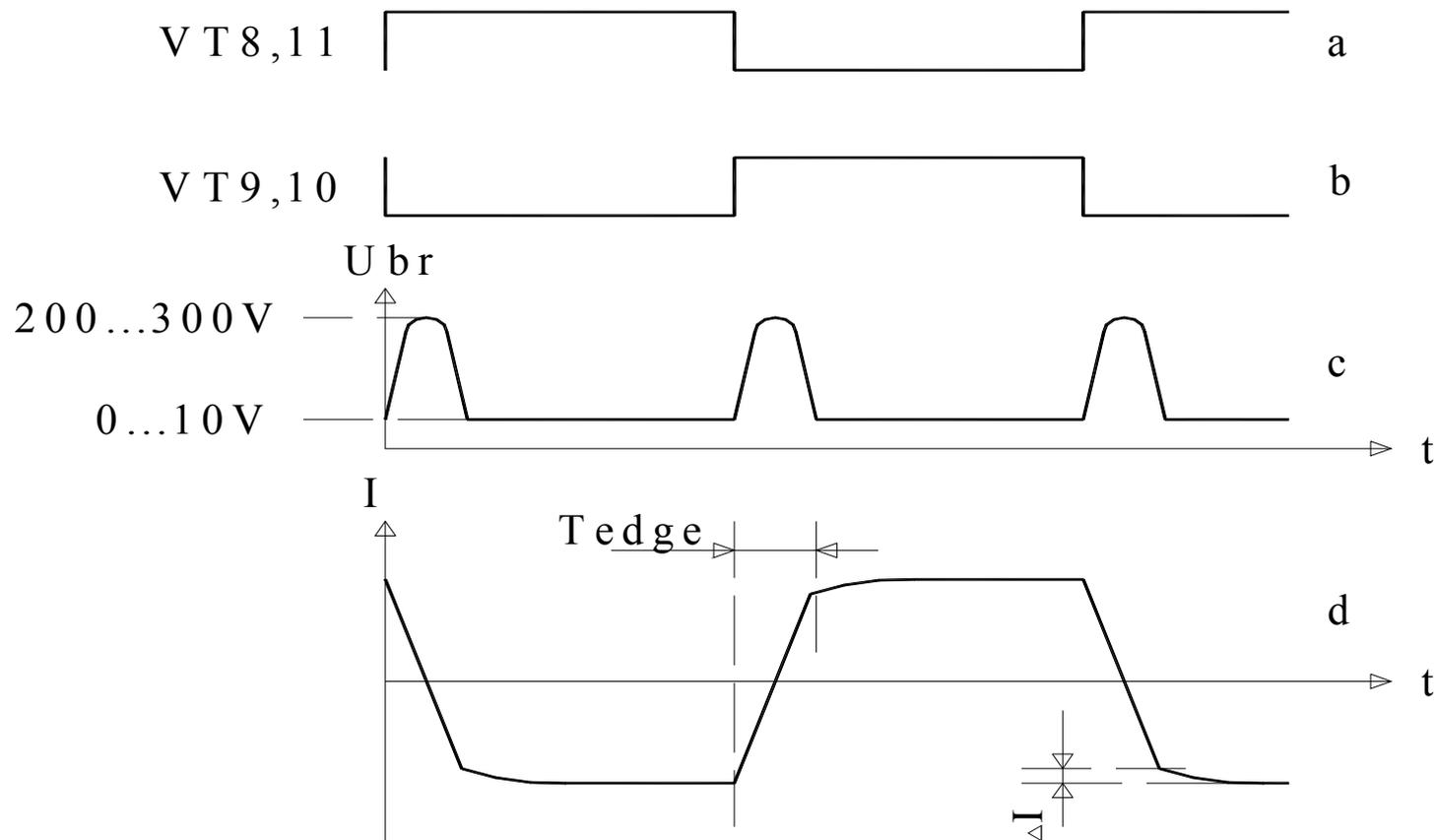
An electron beam trajectories through a two-window extraction device



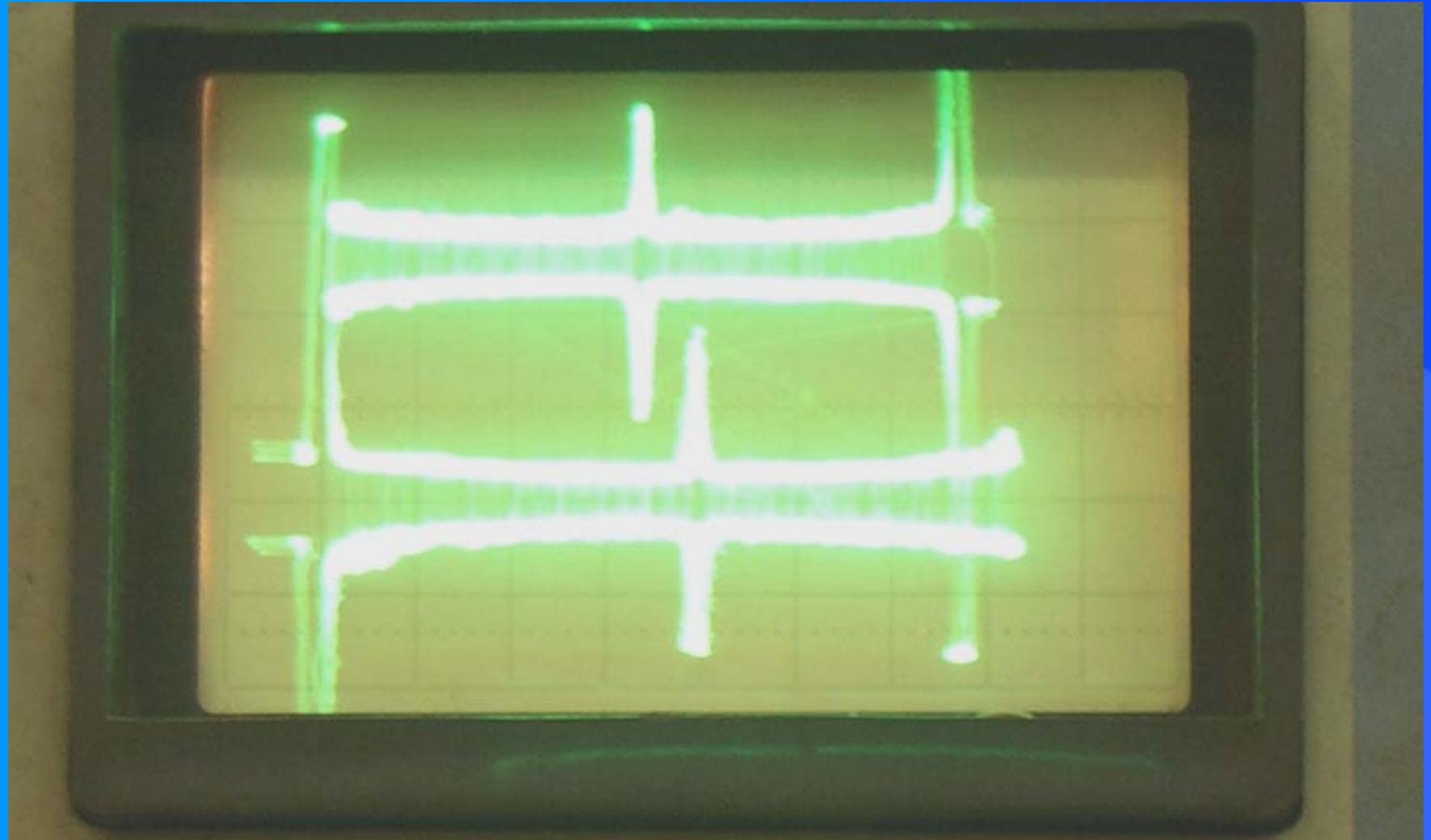
Beam shift unit

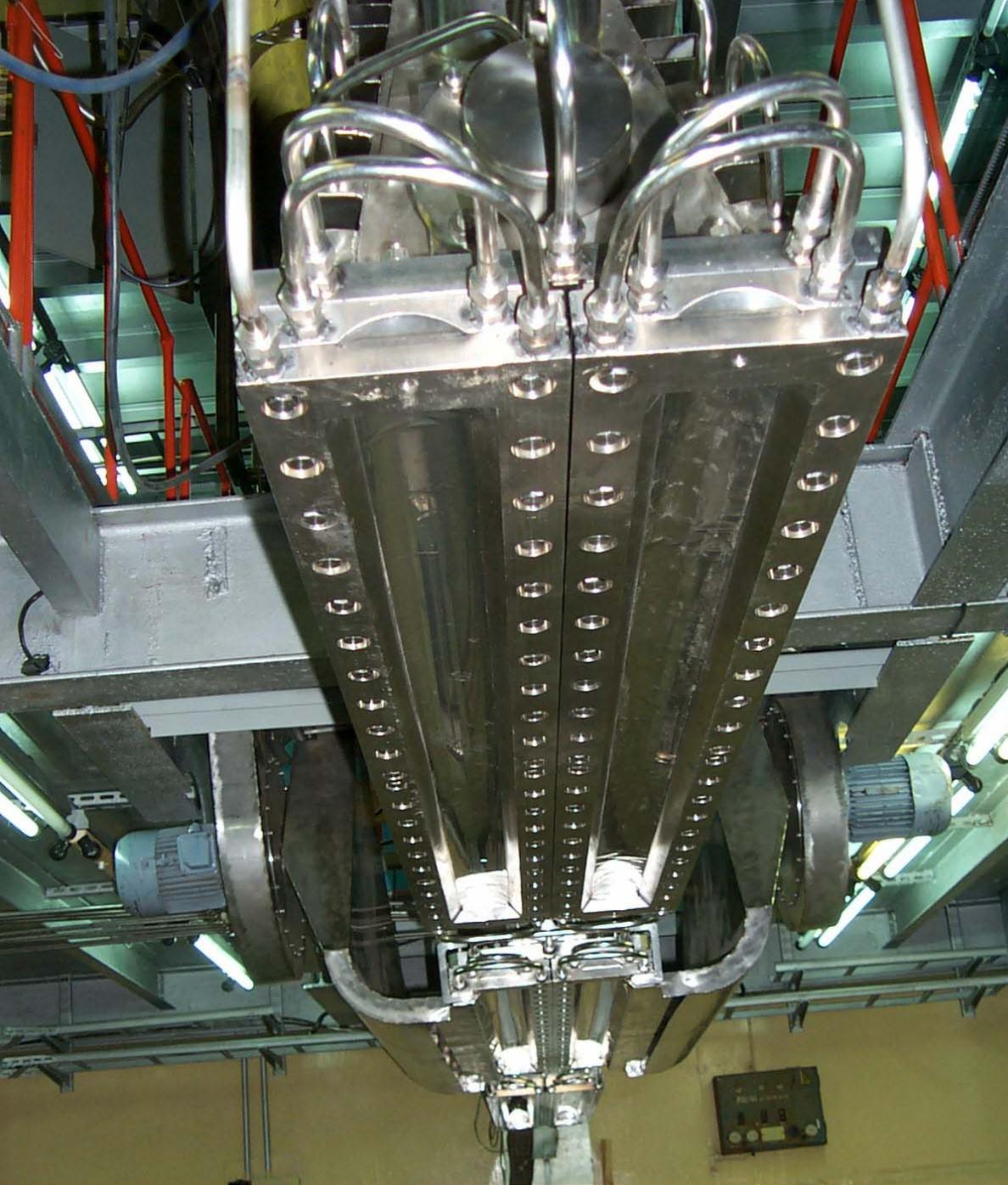


Shapes of BSU signals



- Beam position monitoring





Extraction
device of
ELV-12

Extraction devices



Control system of ELV-12



Water treatment

