



# HIGH-PRECISION RAMPED HIGH-VOLTAGE SOURCE WITH UP TO 50 KV OUTPUT VOLTAGE

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### Abstract

This report describes the precision high-voltage ramped high-voltage power system. The output voltage up to 50 kV with 10 ppm precision. The power system consists of the 3 kW high-voltage source based on multiplier, precision high-voltage divider with digital interface and high-voltage discharge switch to provide low ramp-down time for output voltage. The power system is planned to use in the NIKA booster electron cooler project. The description and test results are presented.

### Description

The presented source was designed as part of electron cooler for booster ring of NIKA project (JINR, Dubna). The booster operating circle scenario is shown on Fig. 1. The electron cooling is planned to use at the injection plato and at the extraction plato. That was reason for some specific terms like: low transient process time after voltage increase, high voltage stability (10ppm) in the full range of output voltage. The high-voltage terminal (see cooler electrical diagram Fig. 2) is the source of 2-3 mA current ripples at 150 and 300Hz. So the high-voltage source have to suppress load voltage variation generated by this ripples to the 10ppm level. The basic characteristics of high-voltage source are shown in Table1.

Parameter	Unit			
		Min	Nom	Max
Output voltage	kV	0.5	50	55
Output current	mA		0.2	10
Output power	kW			3
Voltage ripple	ppm			10
Long term stability	ppm			10
Transient time	ms		100	
Converter frequency	kHz		20	

Table 1. Basic characteristics of precision high-voltage source.

### Design

The high voltage source is made in one 4U crate in the rack of 19" Euromechanics standard, two high-voltage volumes with oil isolation, one for multiplier and one for high-voltage divider and separate suppressor located near the load. The high-voltage divider operates with heated to 40°C oil to the compensate ambient temperature variation.

### Results

The high-voltage source was designed tested and now it ready to use at JINR. The tests are shown high reliability, long term stability better than 5ppm and voltage ripples level less than 10ppm during the operating cycle.

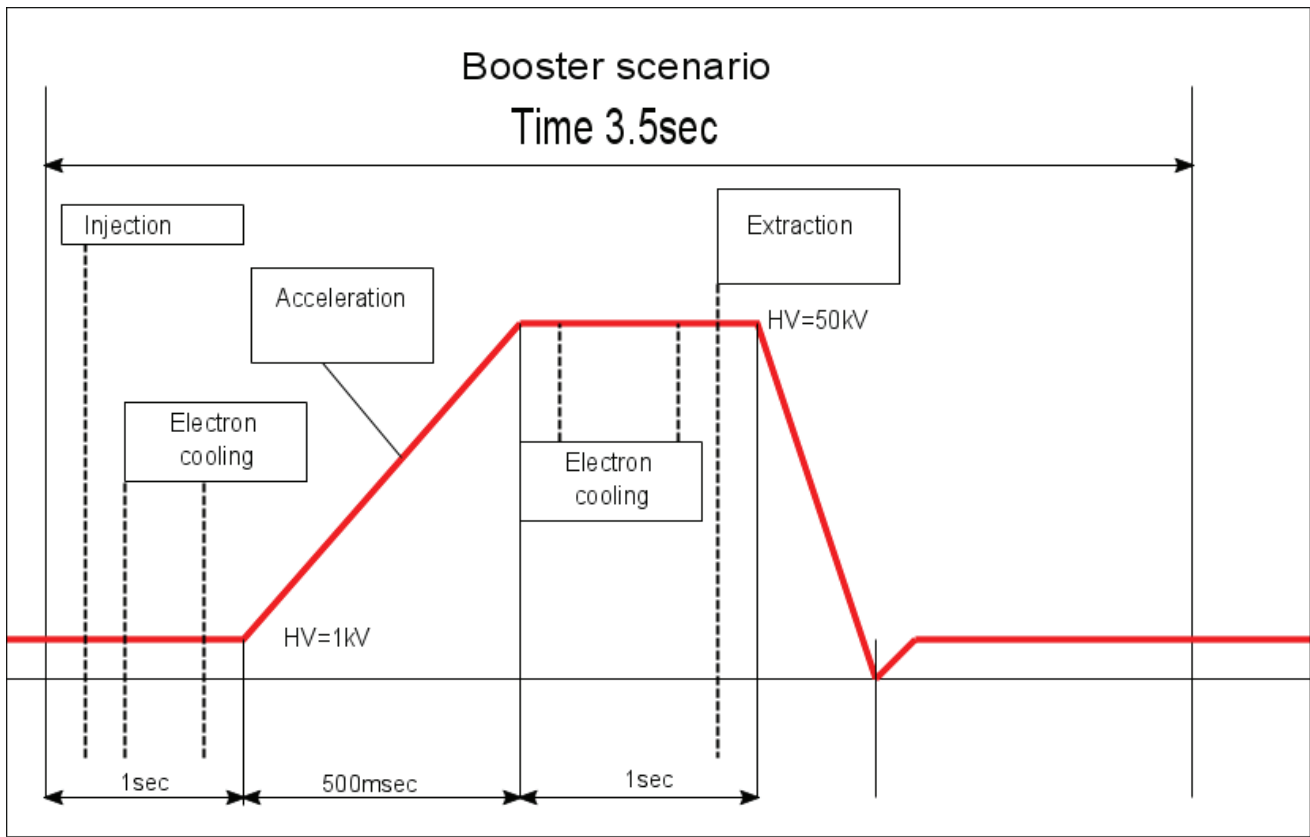


Fig 1

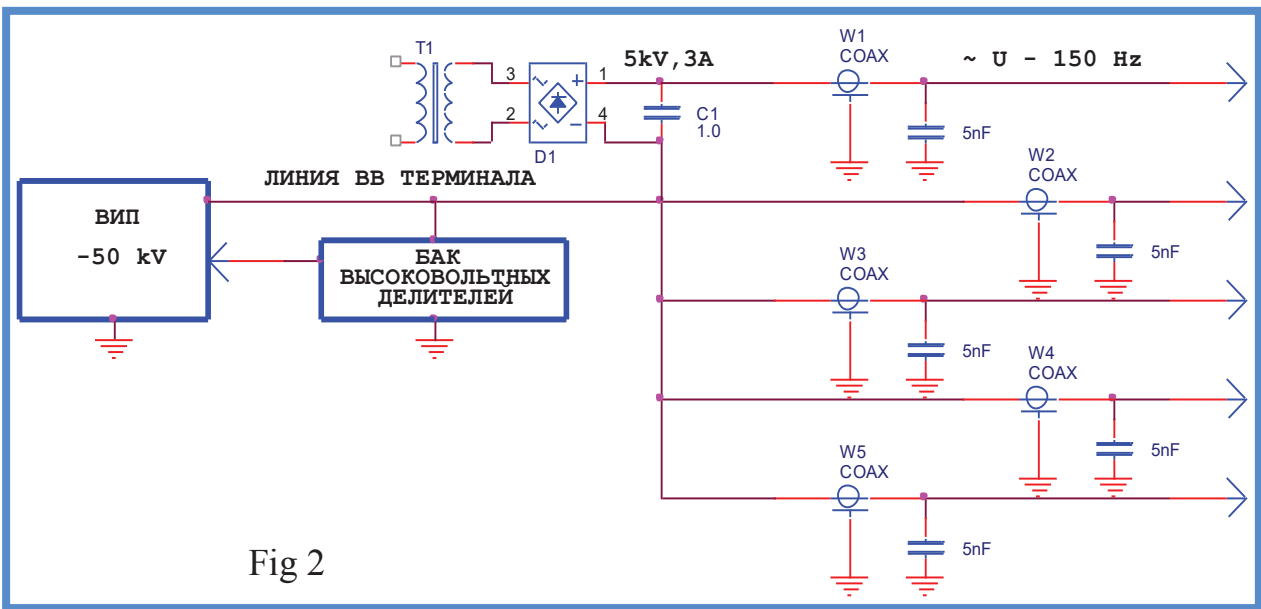


Fig 2

### Overview

The high-voltage source consists of the 20 kHz power converter, high-voltage transformer with the two-stage multiplier (part B) the separate precision high-voltage divider with digital output (Part C) and the ripple suppressor (Part D). The power converter with high-voltage multiplier generates 0-50 kV output voltage. The precision high-voltage divider is used for feedback loop. The analogue ripple suppressor is used to decrease output voltage variations at 150 and 300Hz caused by the external (from load) current ripples. The suppressor increase effective gain of feedback system at these frequencies up to 50-100.



Precision High-Voltage divider with digital output

Supressro ON moment  
The voltage ripples  
decrease from 100ppm  
to 10ppm

