HORIZON 2020 MSCA_AVA- "Accelerators Validating Antimatter physics"

DESIGN,BUILD & PROTOTYPE HIGH STABILITY POWER SUPPLY

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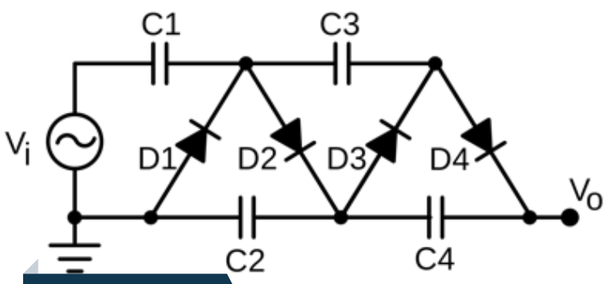
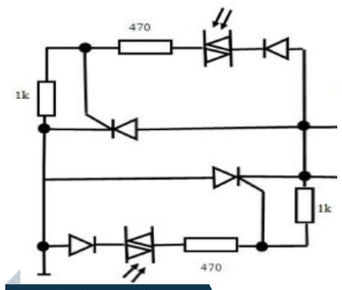
The main aim *is to build a reversible power supply based on voltage multiplier circuit design. Standard power supplies based on voltage multipliers have fixed polarity. We are building a PS that can be electronically reversible.*

Power supply is a very essential part of a typical system. Stability and efficiency of a power supply is one of the important factors for beam storage and energy ramping in a storage ring and beam transportation. FOTON is designing and building a suitable power supply for use in the beamlines and rings within AVA.

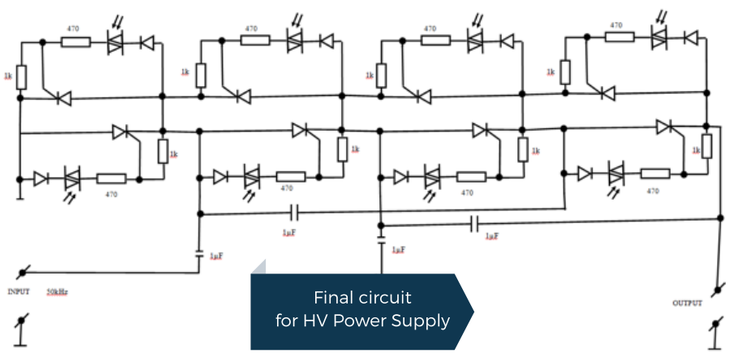
In this project high precision HV power supply is being designed for use in the beam lines and rings within AVA. For this purpose a comprehensive data showing the power supply requirements of all AVA experiments, the ELENA beam lines, as well as the ELENA and FLAIR rings in terms of voltage range, temperature and absolute stability, ramp speeds, etc. was gathered from CERN, GSI & OEAW experiments. This is then being used to define a suitable interface for their seamless integration into the respective accelerator control system.



CW Voltage multiplier topology



Basic topology HV power supply based on CW



Final circuit for HV Power Supply

The topology of HV power supply is based on Cockcroft-Walton Voltage multiplier. 4-step voltage multiplier circuit was then designed to build the high precision high voltage power supply for AVA experiements.

COLLECTION OF DATA FROM GSI, CERN & OEAW

First major task for the project was to collect data of high voltage Power supplies being used at various experiments at AVA partner institutions.

HV Power converters	Nominal Voltage (kV)	Max Current uA)	Voltage Stability (ppm)	Voltage rip-ple & Noise peak-peak	Operating temperature
Correctors (Bipolar 2kV)	±2	500	<50	<5	0 to +40 °C
Quadrupoles (+6kV)	6	500	<50	<5	0 to +40 °C
Quadrupoles (-6kV)	-6	500	<50	<5	0 to +40 °C
Bending (+12kV)	12	250	<50	<5	0 to +40 °C
Bending (-12kV)	-12	250	<50	<5	0 to +40 °C

ELENA HV converrters

Voltage stability (ppm – parts per million of the $V_{nominal}$)	< 2
Voltage ripple and noise peak-peak (ppm) 0.1 Hz – 200 kHz	< 5
Voltage stability (± 10% mains voltage variation)	± 0.02% × V_{nom}
Accuracy of voltage measurement	± (0.01% × V_{out} + 0.02% × V_{nom})
Ramp up/down	0.2 × V_{nom}/s
Voltage setting range	(1-100%) × V_{nom}
Operating temperature	0 to +40°C

CANCUN HV converrters

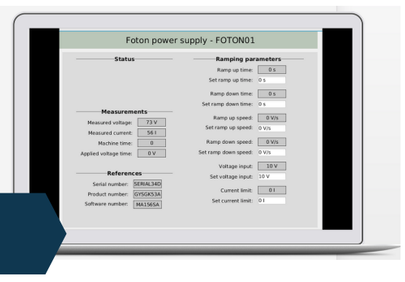
Several more tables are made with data collected from CERN,GSI & OEAW during secondments.

COLLABORATION WITH COSYLAB FELLOW FOR CONTROL SYSTEM DESIGN

For the AVA project, Experimental Physics and Industrial Control System (EPICS) technology is being use to build the control system for this Power supply.

Precise requirements and data have been collected. The control system is being designed by AVA fellow Adi at COSYLAB in Slovenia.

The development of control system for PS includes the definition of signals needing to be monitored, the development of EPICS IOC & database and the design of a user interface.



first draft of Control system design by Adi

NEXT STEPS:

TESTING:

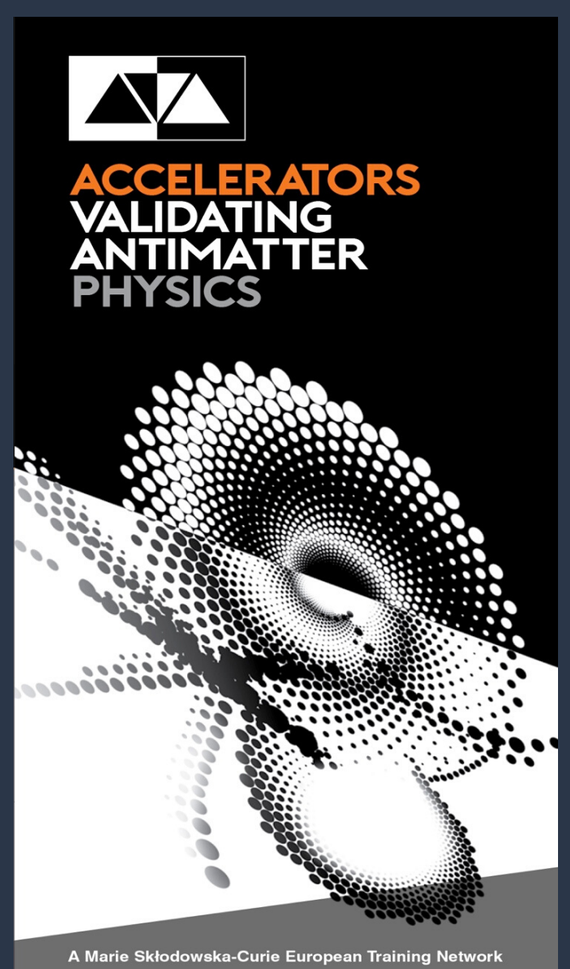
Once all the circuits will be mounted, the testing phase of the power supply will start.

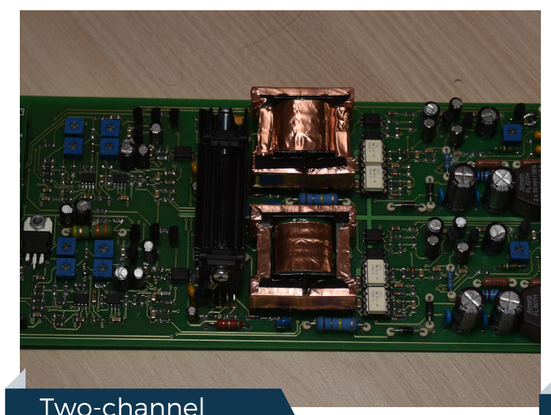
Stability and precision of Power supply will be tested based on the requirements.

Secondment of AVA fellow ADI is planned in coming month to test the control system integration of the Power supply.

The control system program will then be added to the interface module of the power supply.

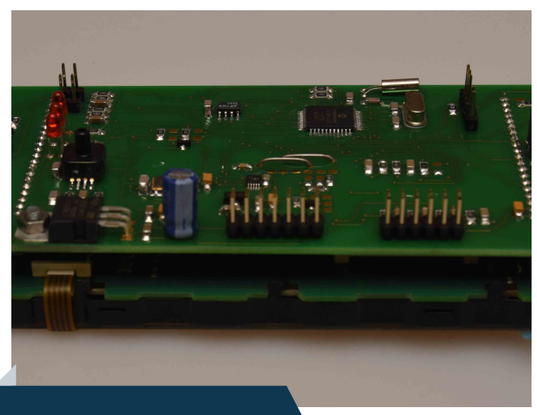
Final testing phase will test the control system integration as well other working conditions according tot he requirements.





Two-channel power supply card

Reversible power supply prototype



Interface module of power supply

FINAL DESIGN PHASE:

The final PCB circuit design is completed. It is now being inclosed in standard industrial mount. The voltage multiplier circuit is driven by a signal generator based on self-oscillating half-bridge driver. Behavior of precise high voltage supply card from FOTON was studied and tested for the output voltage stability

This project has received funding from the European Union's Horizon 2020 research and innovation programme under the Marie Skłodowska-Curie grant agreement No 721559.