A Novel RF Power Source for the ESS-Bilbao Ion Source

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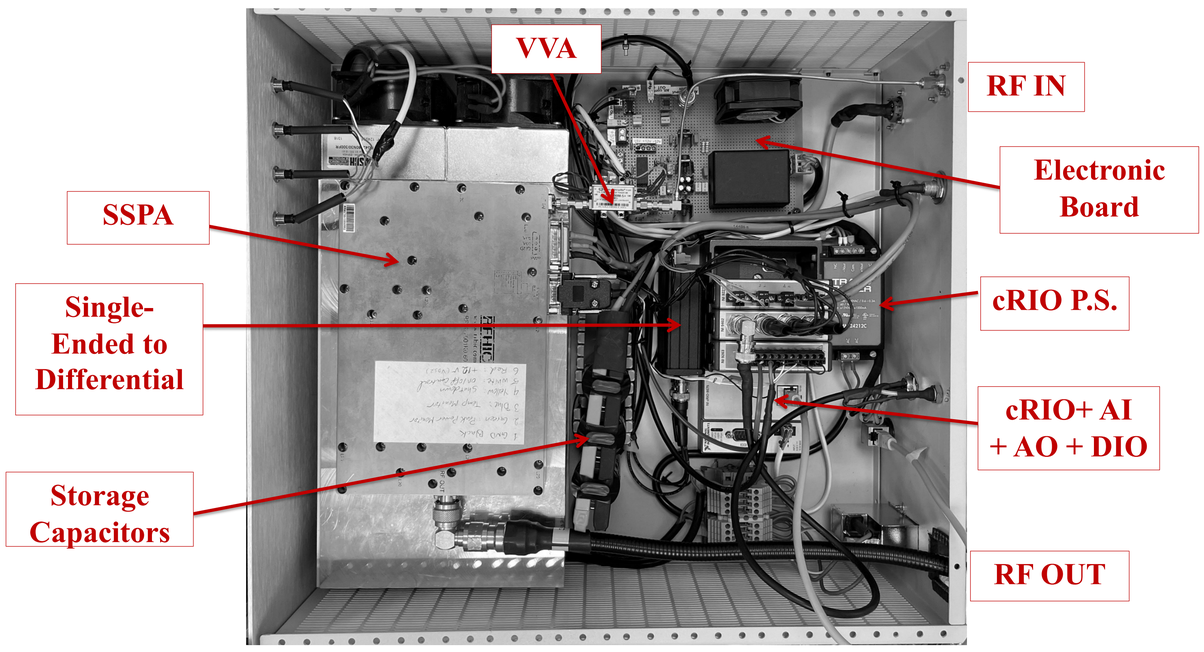
Introduction & Hardware

- Solid-state Power Amplifier (SSPA) based amplification system
- Composed of a SSPA, voltage-controlled RF attenuator (VVA), Compact RIO device (cRIO-9075) and auxiliary electronics

Parameter	Specification	Comments
Frequency	2700 MHz	
Bandwidth	20MHz	2690 – 2710 MHz
Power Gain	62dB	Including the VVA with 10V control voltage
Input RF power max.	-3 dBm	Corresponds to 1kW output power with minimum attenuation at VVA
Output power (max.)	1000w	Including the output cable
Duty Cycle max	10%	
Pulse width max	1.5 ms	
Repetition rate max	66 Hz	
Rise/fall time	200ns	
Mains input	220 -240 V AC	0.2 A normal operation
Auxiliary supply	50V DC, 10A max	External power supply TDK-Lambda G60-17
External P.S.	85-265V AC input, 47-63Hz	0.8 A @ nominal power
Ext. P.S. Dimensions	19”, 1U	TDK-Lambda
Operating temperature	0 – 50 ºC	
SSPA unit Dimensions	423×466×168mm	W×D×H, 4U, 19” rack mountable

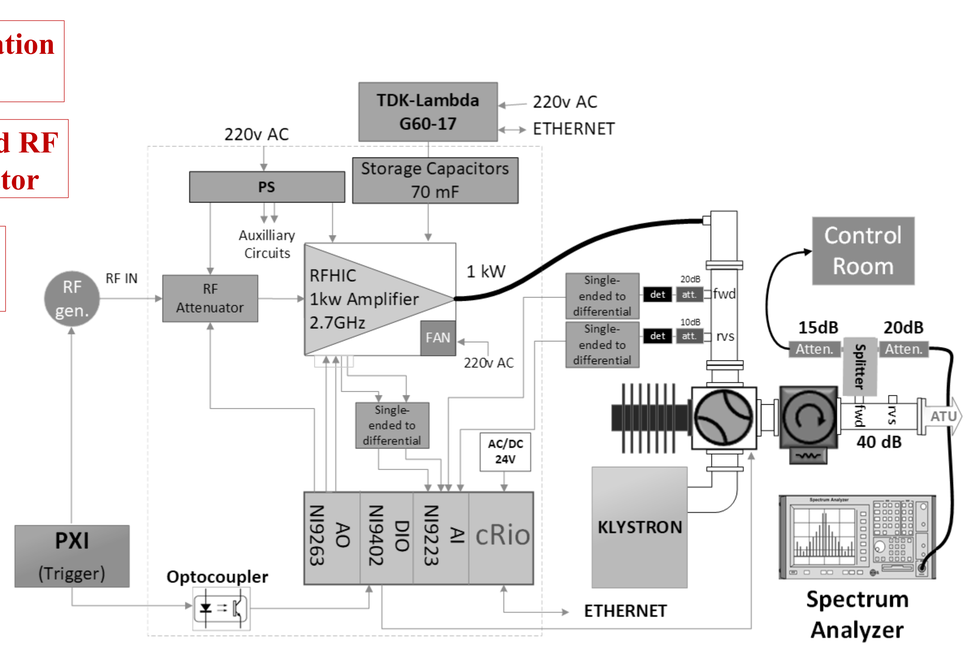
SSPA Unit Specifications



SSPA amplification unit hardware

Installation

- Installed in ESS-Bilbao proton source as alternative RF power source
- A waveguide switch and a load added to the system to select the RF power source for the injector



Injector SSPA-based amplification system scheme

SSPA: on-shelf amplifier designed to work with pulsed RF signal at 2.7 GHz with 10 percent duty cycle.

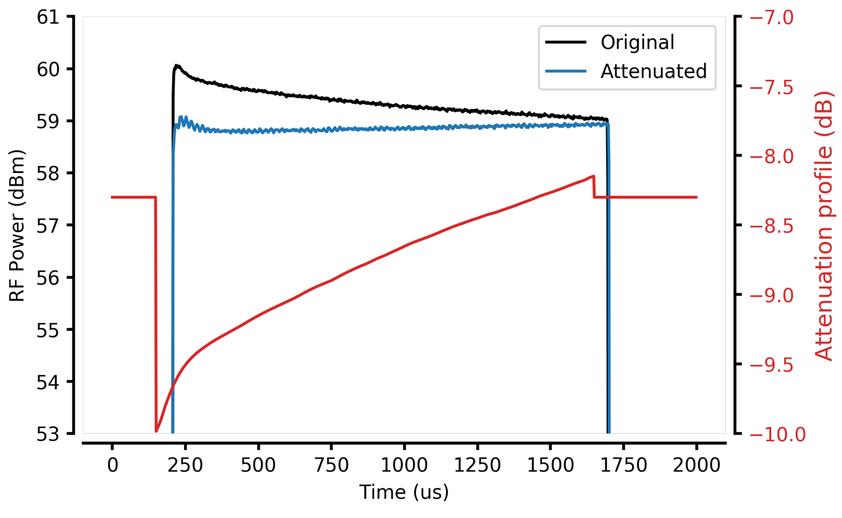
Voltage-controlled RF attenuator: ZX73-2500+ coaxial voltage-variable attenuator adjusts the RF power level at the input of the SSPA to control the RF pulse shape and amplitude.

Compact RIO device: cRIO-9075 works mainly as digitizer for the power measurement signals coming from SSPA input/output power.

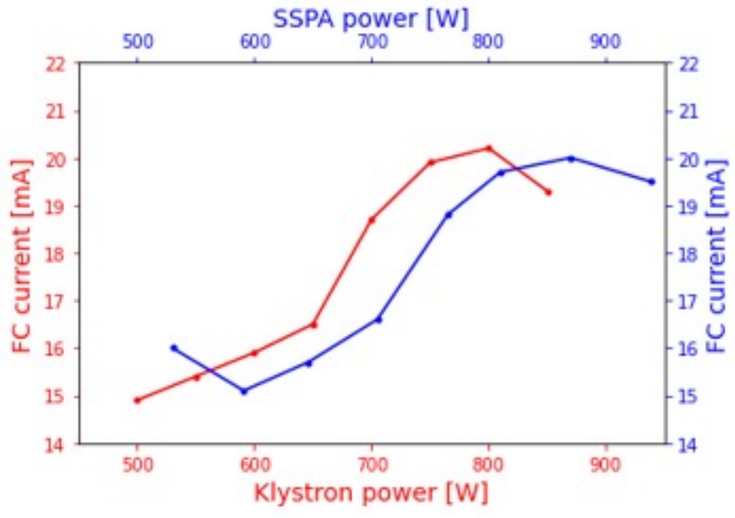
Power Supply: cRIO and SSPA need a DC supply voltage of 24V and 50V respectively.

Control & Tests

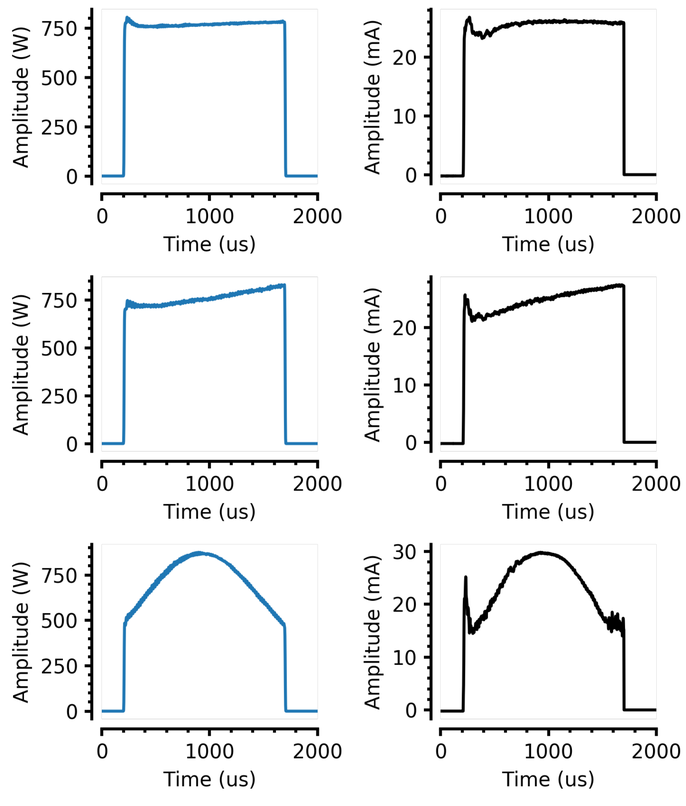
- Output power can be adjusted by a DC attenuation control voltage or alternatively, with an arbitrary control waveform to shape the RF signal envelope
- Beam extraction tests show the effectiveness of SSPA amplification system on beam extraction in comparison with the klystron and the effect of the pulse shape control technique on the extracted beam pulse shape



Variable attenuation control signal example



Beam extraction comparison between SSPA system and Klystron at different output power



SSPA system beam extraction at different pulse shapes