



Automatic RF and Electron Gun Filament Conditioning Systems for 6 MeV LINAC

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Introduction

RF conditioning of vacuum windows and RF cavities is a necessary task for eliminating poor vacuum caused by outgassing and contamination. Also, startup and shutdown process of linear accelerator requires gradual increase and decrease of electron gun filament voltage to avoid damage to the filament. This poster presents an EPICS based multi-loop automatic RF conditioning system and Electron Gun filament conditioning system for Klystron based 6 MeV Linear Accelerator.

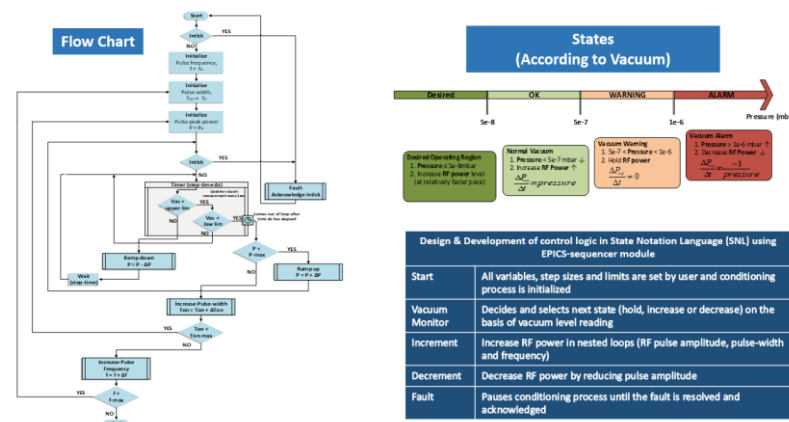
RF Conditioning System

- ✓ Gradual Increase of injected RF power to avoid breakdowns
- ✓ Direction and magnitude of power gradient is adjusted on the basis of vacuum dynamics of LINAC cavity
- ✓ Design & development of automatic RF conditioning system using EPICS
- ✓ Incorporation of alarms and interlocks
- ✓ Hardware Setup
 - ✓ Siemens PLC (digital and analog I/Os)
 - ✓ Field Devices (vacuum gauge controller, signal generator, oscilloscope, delay generator and klystron)
 - ✓ Sensors & Relays (temperature switches, arc detector, flow meter, and RF-switch)
- ✓ Software Design
 - ✓ Configuration of main control software in EPICS
 - ✓ Development of soft I/Os for interfacing PLC, hardware electronics and field instruments
 - ✓ Implementation of control logic and conditioning algorithm using EPICS sequencer program
 - ✓ Data archiving and alarms
 - ✓ Development of front-end application using Phoenix

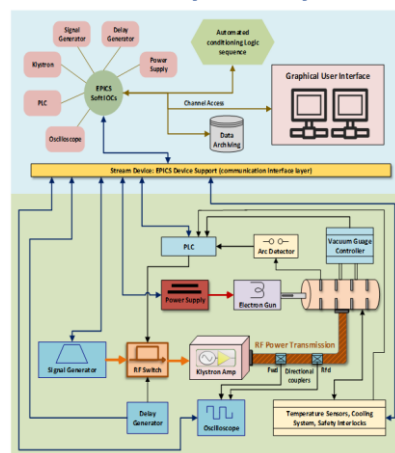
Electron Gun Filament Conditioning System

- ✓ Low voltage conditioning of electron gun filament is necessary for safe operation
- ✓ Applied voltage is ramped up in steps while constantly monitoring vacuum level of accelerator cavity
- ✓ Development of software and hardware setup for automatic ramp-up/down of electron gun filament voltage
- ✓ Interfacing of e-gun power supply with EPICS IOC using TCP/IP communication protocol
- ✓ Interfacing of vacuum gauge controller with EPICS to monitor pressure level
- ✓ Development of ramp-up/down algorithm using EPICS sequencer module
- ✓ Integration of safety interlocks
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Conditioning Strategy

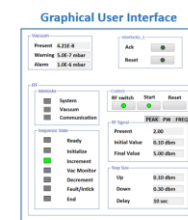


Control System Layout

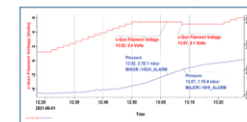


Results

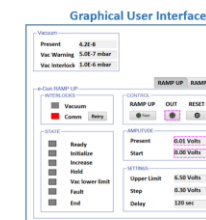
RF Conditioning System



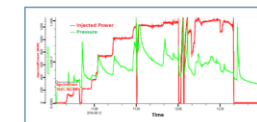
Data Browser History



Electron Gun Filament Conditioning System



Data Browser History



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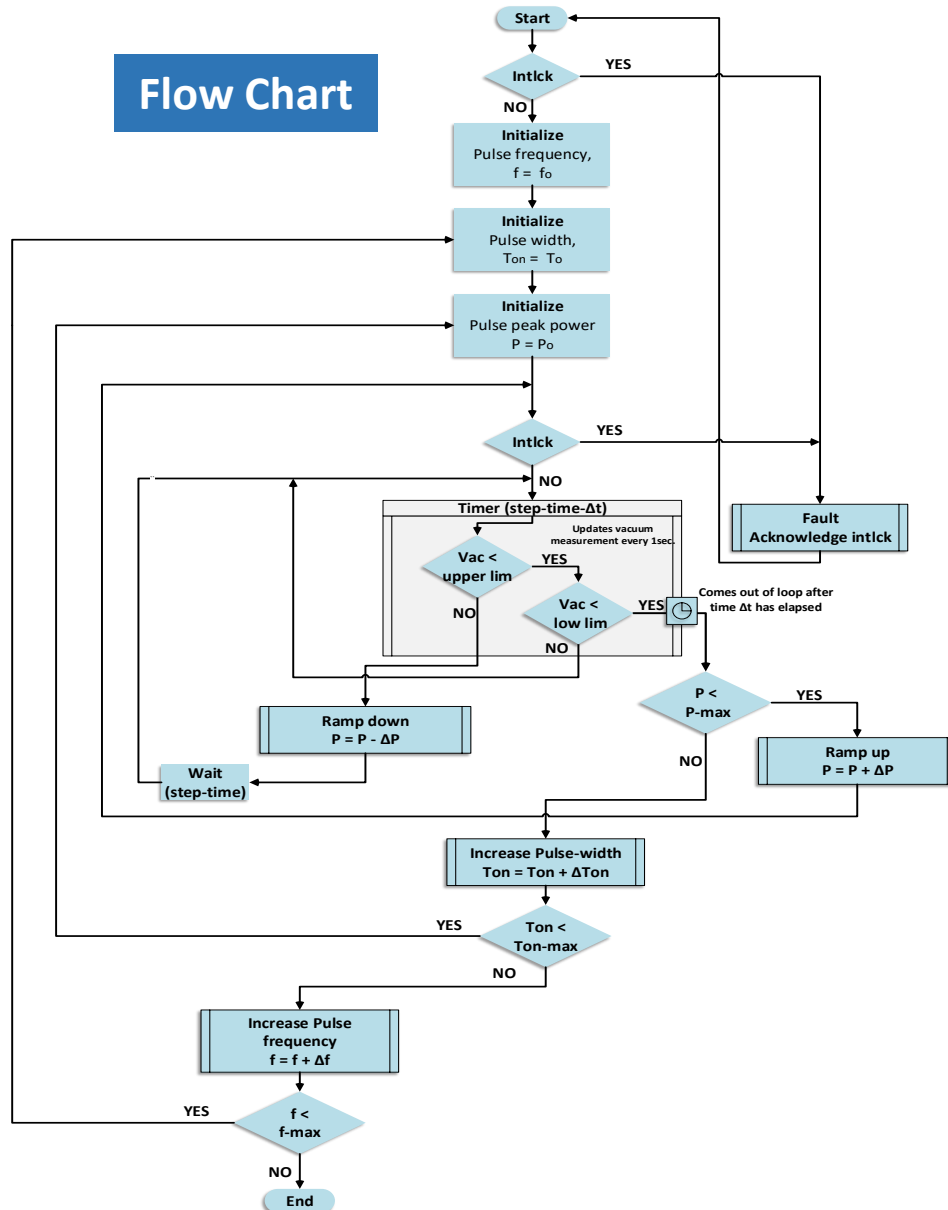
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Electron Gun Filament Conditioning System

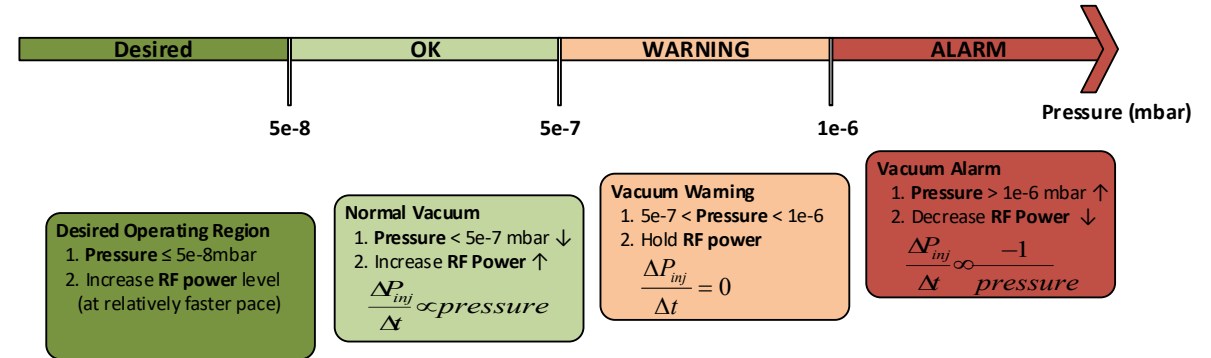
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Conditioning Strategy

Flow Chart



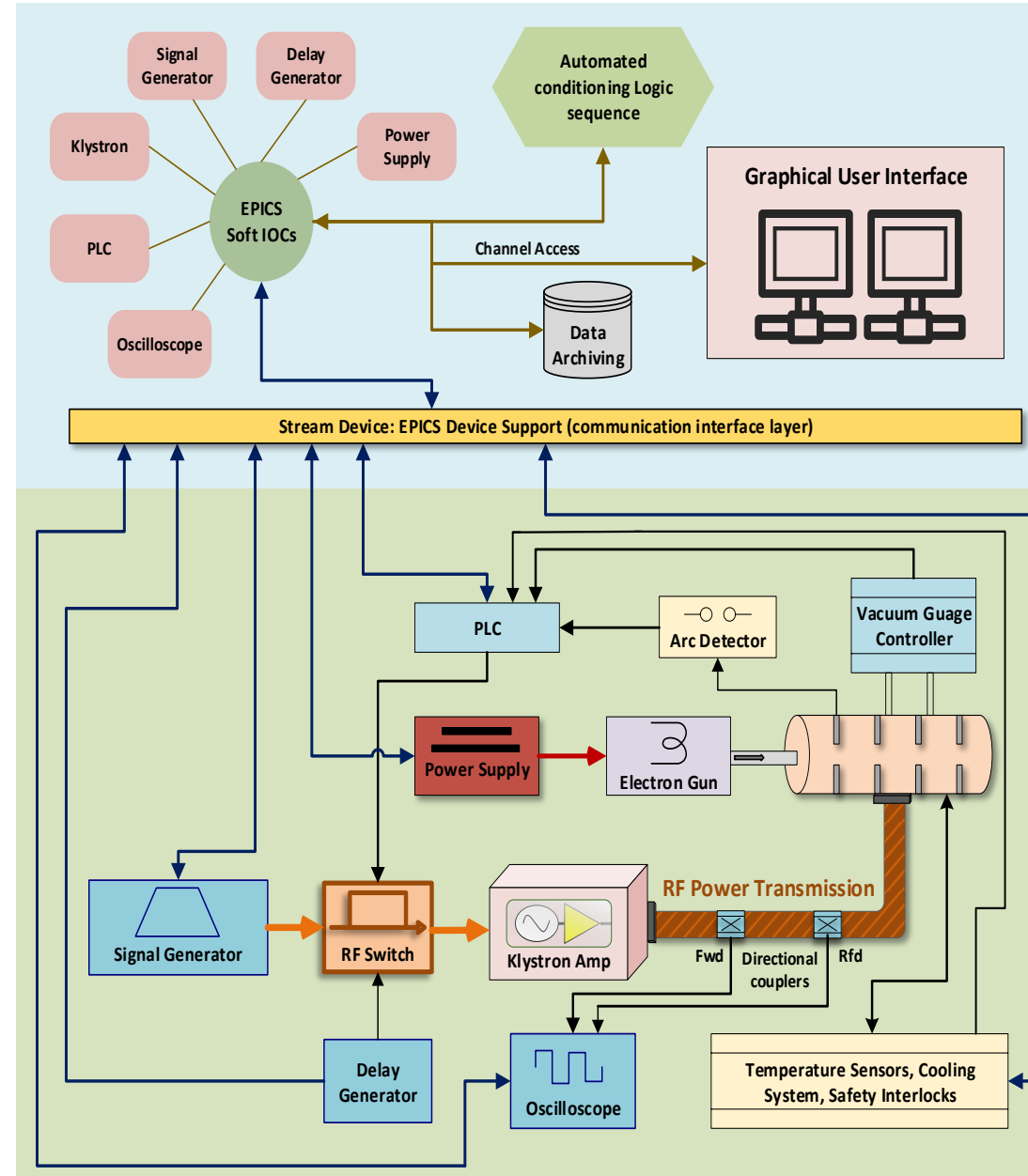
States (According to Vacuum)



Design & Development of control logic in State Notation Language (SNL) using EPICS-sequencer module

Start	All variables, step sizes and limits are set by user and conditioning process is initialized
Vacuum Monitor	Decides and selects next state (hold, increase or decrease) on the basis of vacuum level reading
Increment	Increase RF power in nested loops (RF pulse amplitude, pulse-width and frequency)
Decrement	Decrease RF power by reducing pulse amplitude
Fault	Pauses conditioning process until the fault is resolved and acknowledged

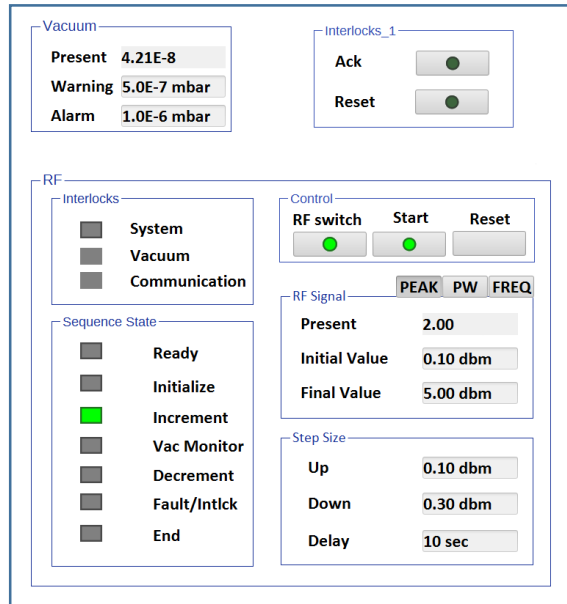
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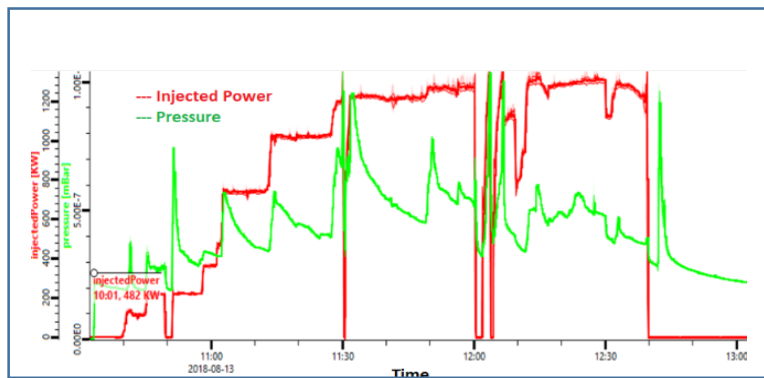
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RF Conditioning System

Graphical User Interface

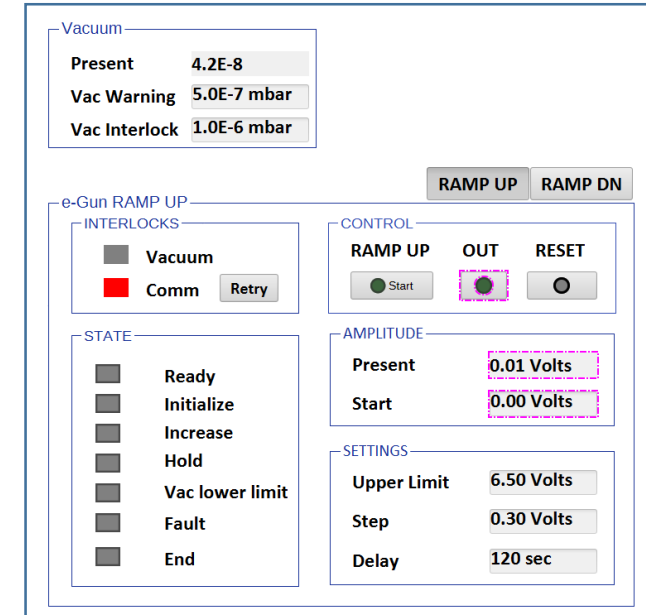


Data Browser History



Electron Gun Filament Conditioning System

Graphical User Interface



Data Browser History

