OVERVIEW OF CONTROL SYSTEM FOR 30MeV RF SOURCE

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Control system for RF source of 30 MeV, 3 kW RF Linac for neutron generation is being developed. The system consists of two 15 MeV linac structures, each powered independently with klystron rated for 7.5 MW(pk)/7.5 kW(avg). Two klystron modulators of 160kV, 110A, 7µs and 250Hz feed pulsed power into the klystron, which produces RF power at 2856 MHz. The klystrons will be driven by low power RF driver amplifiers programmed for matching phase, frequency and power into the linac. Both the driver amplifiers are controlled through RS-232 Protocol. The HV pulsing and RF drive for the klystron has been interlocked with water flow, arc detector, SF6 gas pressure etc. The control system is designed using Real time embedded controller, where pulses for synchronization are being generated in FPGA. Most of the power supplies like electromagnet, HVDC, etc. are on RS-232 protocol. These power supplies are controlled via suitable RS-232 to Ethernet converter. State machine topology is being used to design the logic. The database for logging data is developed in SQL.

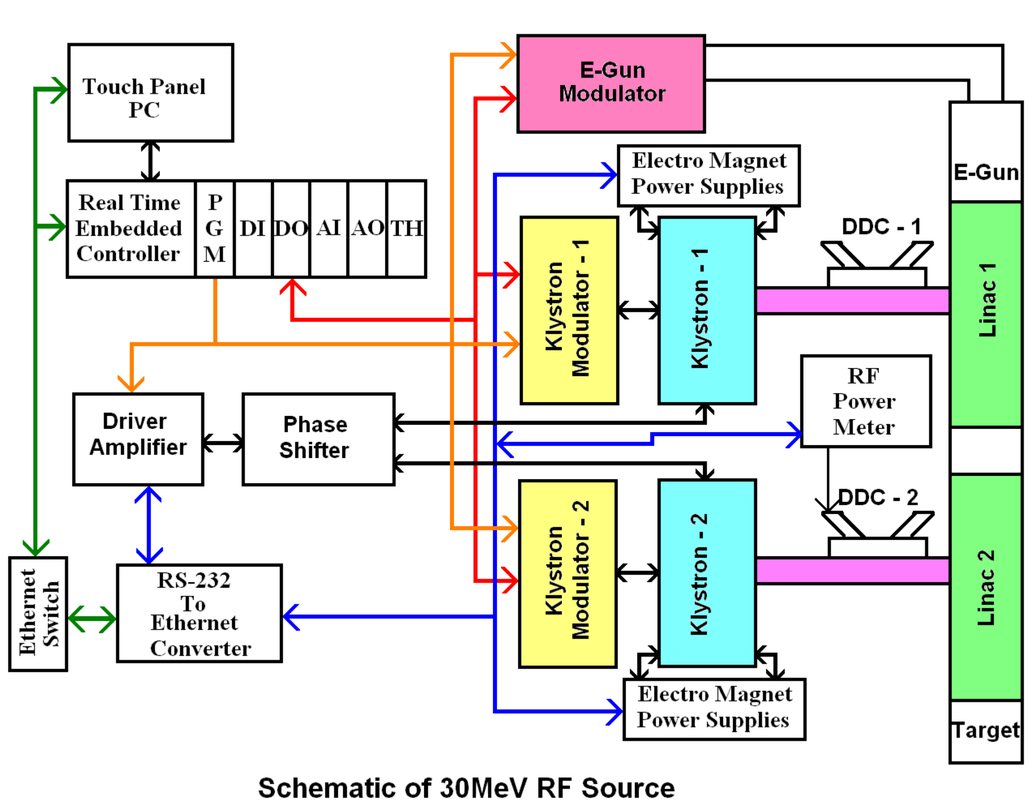

Fig 1. Schematic of 30MeV RF Source

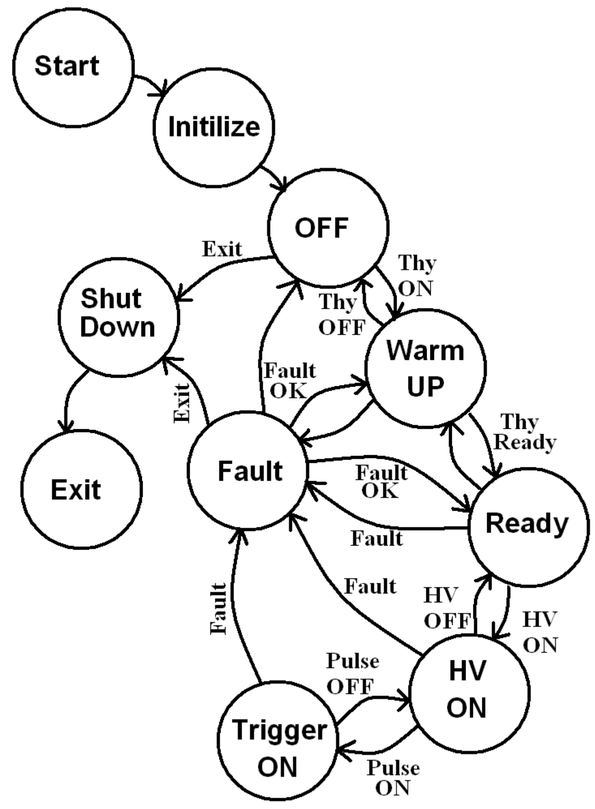

Fig 2. State Machine Diagram for Control System

DETAILS OF SOFTWARE

The design is based on State Machine Architecture. It gives an abstract description of the behavior of the system. This behavior is analyzed and represented in series of events that occur in one or more possible states. The state transition diagram for the control was prepared. It consists of 7 states viz Initialize, OFF, Warm up, Ready, HV ON, Trigger ON, Fault state and Shut down. Based on state diagram logic/flowchart was designed. Fig 2. shows the state machine diagram for implementation of the algorithm for the control system.

DETAILS OF HARDWARE

The system consists of Real time embedded controller with FPGA for pulse generation logic. The controller is connected to the input output modules with 8 slot chassis. As per the requirement provision for 1PGM (Pulse Generation Module) 16DI, 16DO, 8 AI, 4 AO and 4 Thermocouple channels has been given. Two 4-ports RS-232 to Ethernet converter is used for controlling RS -232 protocol devices like electromagnet power supplies, driver amplifier, RF power Meter etc.

Analog – Digital Isolation

ADAM 3014 signal conditioning isolation module is used for protecting analog processed signal from ground loops, other electrical interferences. It provides channel - channel optical isolation of 1kV DC. Relay is used between digital channel and the field signal. It provides physical isolation between the signals.

Fiber Optic pulse transmission circuit

For transmitting the TTL trigger pulse Fiber optic pulse transmission circuit was designed and developed. The TTL pulse generated by pulse generation module is fed to HFBR 1412 – Transmitter and the signal is transmitted over fiber optic to HFBR 2412 – Receiver kept near the trigger circuit of the individual system, where the fiber optic signal is converted back to electrical signal.

SALIENT FEATURES

- Generation of pulses with synchronization
- FPGA for pulse generation logic
- Monitoring in real time mode of all the interlocks / critical parameters like vacuum, Arc, water temperature
- Protection of the controller from radiated and conducted noise.
- Date wise Database record viewing facility
- On Line Data Storage
- User Friendly GUI

TESTS

Pulse generation logic was tested for synchronization between e-gun modulator, driver amplifier and klystron modulator. The pulses have adjustable pulse width from 0.1µs to 4µs and adjustable pulse delay with steps of 0.1us. Faults were simulated and the logic of the interlocks was tested successfully.

CONCLUSION

The development of the above described control system is complete. Control of few supplies is being done remotely through PC. The testing of the system with Klystron modulator on actual operating conditions is awaited.