

Control Application Development for 324 MHz Superconducting Spoke Cavity Coupler RF Conditioning Test Platform

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Introduction

Introduction

A 324 MHz superconducting spoke cavity coupler RF conditioning test platform is building in CSNS (China Spallation Neutron Source) linac klystron gallery to let couplers fully outgassing to prevent the contamination of the superconducting cavity during the actual operation.



Couplers, resonator and ion pump.



Klystron, waveguide, circulator and load.

Introduction

In September 2020, a set of MTCA digital low-level hardware platform was purchased from German struck company. Based on the current control scheme of CSNS linac, some similar functions, such as feedback control and VSWR protection, are implemented on this MTCA. In addition, due to the requirement of 324MHz superconducting spoke cavity coupler RF conditioning platform, a RF conditioning control software needs to be developed.



LLRF control system for RF conditioning test platform.





System Architecture of Test Platform



The system has power monitoring and VSWR protection, power limit protection functions. Maximum power output: traveling wave rf conditioning 1 MW, standing wave rf conditioning 400 kW.

The protection system needs to monitor 3-way vacuum data, 8way arc signals, cooling water velocity, temperature data at 18 places and 2-way secondary electron multiplication detection signals.

Software Architecture



RF Conditioning programs can be implemented though SNL (State Notation Language) by installing re2c and seq plugins under EPICS architecture. Its function belongs to the Sequencer in the left picture.

By calling the PVs that IOC has released, Sequencer can implement some programs with simple single functions but numerous items. It is implemented inside the IOC, even if the industrial computer is disconnected, as long as the MicroTCA is normal, it will not affect the normal operation of the program.

The industrial computer adopts CSS (Control System Studio) software to realize the control interface, which mainly completes the parameter setting, switch, and data display.

Implementation of data interaction between OPI and hardware (Creating PVs)



Run two IOCs simultaneously in one machine



In order to allow RF conditioning IOC to use the PVs of LLRF IOC, both of them need to run at the same time.

To this end, we reset the UDP port number in the st.cmd file of IOC and the Channel Access option of CSS.

PART THREE

Functions of Application

Basic Idea of RF Conditioning Procedure.



Basic Idea of RF Conditioning Procedure.



SNL State



Crisis Plan

Crisis management in the rising stage (Level 1)



PART FOUR

Test Results

Offline Test



Joint Commissioning with Vacuum Equipments

AKV ON/OFF



Real Control Interface



Both IOCs are working normally.

Re Edit View Search Terminal Help

LLRF IOC



10 nstall driver.sh sis83001 tests test sis8325 tests universal sis8800 tests versions.txt 2c-1.1.1 sis8864 tests hep@localhost EPICS]\$ cd rfgo ihep@localhost rfgo]\$ cd iocBoot/iocgo/ hep@localhost iocgo]\$./st.cmd !../../bin/linux-x86 64/go ## You may have to change go to something else # everywhere it appears in this file picsEnvSet("EPICS CA SERVER PORT", "5066") envPaths picsEnvSet("IOC","iocgo") epicsEnvSet("TOP", "/home/ihep/EPICS/rfgo") epicsEnvSet("SNCSEQ","/home/ihep/EPICS/synApps 6 1/support/seq-2-2-6") picsEnvSet("EPICS BASE","/home/ihep/EPICS/base-3.15.6") plcsEnvSet("ASYN","/home/ihep/EPICS/synApps 6 1/support/asyn-R4-36") DicsEnvSet("CALC","/home/ihep/EPICS/synApps 6 1/support/calc-R3-7-3") epicsEnvSet("SSCAN","/home/ihep/EPICS/synApps 6 1/support/sscan-R2-11-3") epicsEnvSet("STREAM","/home/ihep/EPICS/synApps 6.1/support/StreamDevice-2-8-9") picsEnvSet("PCRE INCLUDE", "/usr/local/include") epicsEnvSet("PCRE LIB", "/usr/local/lib") cd "/home/ihep/EPICS/rfgo" ## Register all support components bLoadDatabase "dbd/go.dbd" go_registerRecordDeviceDriver pdbbase epicsEnvSet("STREAM PROTOCOL PATH", ", ") drvAsynIPPortConfigure("COM1", "10.1.205.111:4001") drvAsynIPPortConfigure("COM2","10.1.205.111:4002") #drvAsynIPPortConfigure("COM3","10.1.205.111:4003") ## Load record instances dbLoadTemplate "db/user.substitutions" scLib: macro dev is undefined (expanding string lot):SP AMP.VAL NPP NMS") #field(INPA, "\$(dev)-s\$(s acLib: macro slot is undefined (expanding string Lot):SP AMP. VAL NPP NMS") #field(INPA, "\$(dev)-s\$(s arning: 'db/dbExample1.db' line 84 has undefined macros dbLoadRecords "db/dbSubExample.db", "user=ihep" dbLoadRecords "db/ip.db" bLoadRecords "db/gauge.db" bLoadRecords "db/ccg.db" ## Set this to see messages from mySub ar mySubDebug 1 ## Run this to trace the stages of iocInit cd "/home/ihep/EPICS/rfgo/iocBoot/iocgo" arting iocInit W EPICS Base built Feb 25 2021

PART FIVE

Summary

Summary

In order to meet the requiremnets of the superconducting cavity coupler RF conditioning, we have designed and developed a corresponding RF condition control application on the LLRF system of the test bench. The main program of this application is mainly completed on EPICS IOC through SNL language. The corresponding control interface is completed in CSS (Control System Studio).

The results of offline testing and joint debugging of vacuum equipments show that the application is working normally and can be used in the next step.

THANK YOU