REIXS Beamline
Reference Manual

(Work in Progress)

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1.0 Introduction

The Resonant Elastic and Inelastic Soft X-ray Scattering (REIXS) Beamline is a soft X-ray beamline dedicated to soft X-ray scattering and soft X-ray spectroscopy experiments. The beamline is located at 10ID-2 port of Canadian Light Source.

This document describes the setups and calibration of REIXS Beamline.

2.0 Advanced Controls

2.1 Starting the Beamline from Scratch

All valves closed

2.1.1 Beamline Pump Down

If one vacuum section has been vented, use turbo cart to pump down to below 10^{-6} Torr. Bakeout the section.

Pumps, pump down individual vacuum sections, bakeout

Before a power outage, close all gate valves to isolate each vacuum section. If the power outage is less than 2-3 days, usually the vacuum can be recovered by turning on the ion pumps in each section. Otherwise, use turbo cart to pump down each section to below 10^{-6} Torr before turning on the ion pump.

2.1.2 RSXS Endstation Pump Down

Turbo pump for scattering chamber and load lock.

Pump down the Cryo pump by either chamber turbo pump or through the roughing port on the cryo pump. Then start cryo pump.

Pump down the Thermionics 2L/s ion pump for the rotary feedthrough differential pumping. Close the valve to turbo roughing line. Connect a turbo cart, open both valves on the differential pumping line. Pump the differential pumping line to $<10^{-6}$ Torr, then start the ion pump. Current < 5mA?? Close the valve besides the 2L/s ion pump. Close the valve to turbo cart. Open the valve to 700L/s turbo roughing line.

2.1.3 Turn on the Electronics

IOC1610-201

OPI1610-201

OPI1610-202

IOC1610-403

Start VME crates

Start NIM crate

Start control software for the beamline

3.0 Beamline Setup

Power ready

Air ready

Cooling ready

Vacuum ready.

3.1 Calibrating the Beamline Components

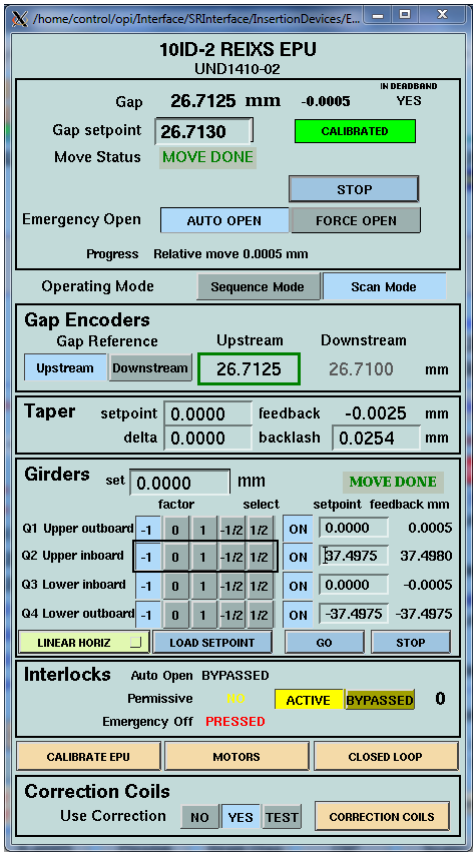
3.1.1 EPU Calibration

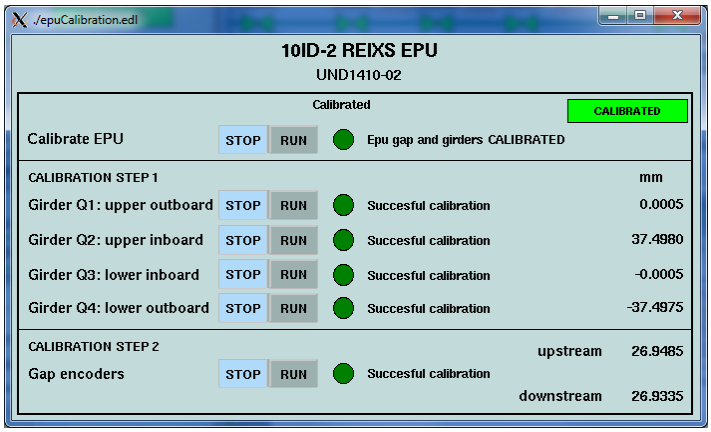
For qualified beamline staff only.

The REIXS EPU Control can be accessed by typing: `runREIXS_Epu &` from a command line window (xterm), or click the [R-EPU] button in the REIXS Advanced Control Interface.

Clicking the [Calibrate EPU] button will bring up the EPU Calibration panel. Clicking [Run] button in the "Calibrate EPU" line will automatically calibrate all five motors on the REIXS EPU. Clicking other [Run] buttons will calibrate individual motors. When all the motors are calibrated, the calibration status shows Calibrated with green beackground.

Other details of the REIXS EPU could also be accessed from this interface. **DO NOT** make adjustments without comprehensive knowledge of EPU control.



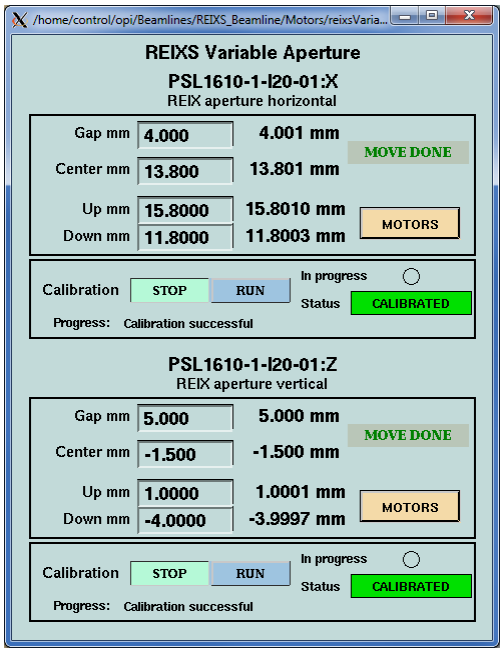


3.1.2 Calibrating Apertures and Slits

REIXS Beamline has several apertures / slits.

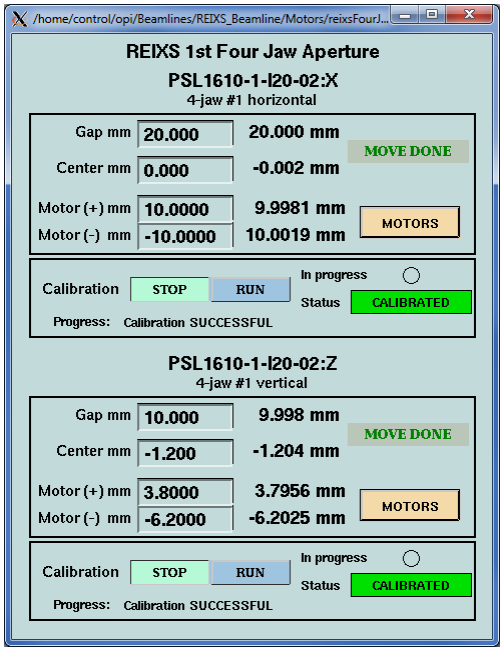
3.1.2.1 *Variable Aperture*

Variable Aperture



3.1.2.2 *4-Jaw #1 and 4-Jaw #2*

4-Jaw #1 and 4-Jaw #2



3.1.2.3 *Exit Slit*

Exit Slit has four motors.

Vertical gap: beam based calibration

Inboard and outboard blade motors are the same as 4-Jaw motors.

Roll motor

3.1.3 Calibrating Mirror positions

For qualified beamline staff only.

It is not necessary to move the mirrors for encoder calibration. Use procedure below for every motor / encoder pair for each mirror:

1. Open motor control interface for one motor.
2. Verify the settings for motor velocity, base velocity and acceleration. Make corrections if needed.
3. On Power/Backlash tab, turn off the Motor Power.
4. Go to Calibration tab, verify the values of Step Slope, Encoder Slope and Calib Position. Make corrections if needed.
5. Click the Home CW button. The motor feedback value should be changing.
6. Go to the corresponding motor, push the encoder tip back. Once the reference mark is detected, the motor feedback value will stop. The encoder is calibrated now.
7. Go back to Power/Backlash tab and turn on the motor power (or Auto Hardware for some motors).

Other details of the motor could also be accessed from this interface. **DO NOT** make adjustments without comprehensive knowledge of motor control.

3.1.4 Calibrating Chopper

Chopper must rotate in the positive direction for correct operation. If the chopper has moved in negative direction, it must rotate in positive direction for one revolution, so that the encoder can pass the home position reference mark and establish the correct angle readout.

LED indicators on the Chopper Controller in the NIM Crate show the status of the chopper system.

Once chopper is stopped, use "Move Relative" to adjust chpper position.

[SYNCD] – Chopper calibrated

[DS1] – Data stream 1 (REIXS EPU Beam)

[DS2] – Data stream 1 (SM EPU Beam)

3.1.5 Monochromator Calibration

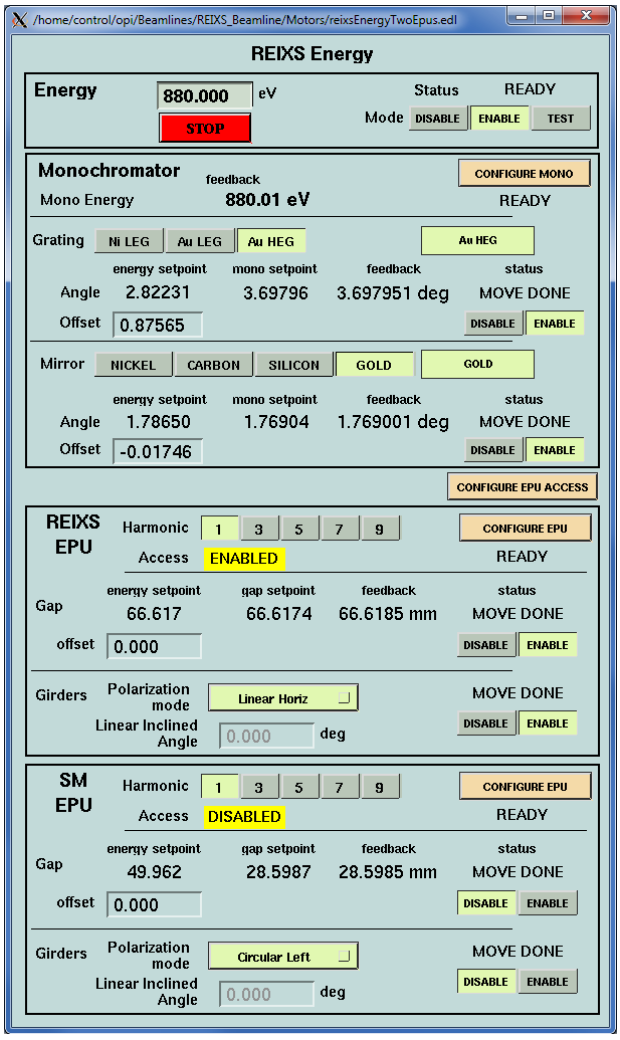
For qualified beamline staff only. DO NOT make adjustments without comprehensive knowledge of monochromator control.

Verify motor parameters: velocity, base velocity, accelaration

Translation motors calibration

In the "REIXS Energy" panel, click [ENABLE] button to activate the energy control. Use the input box to set the energy for monochromator and EPU. Click [Stop] button to stop all motors of monochromator and of EPU immediately. "Status" shows if the monochromator and EPU have reached correct setpoints.

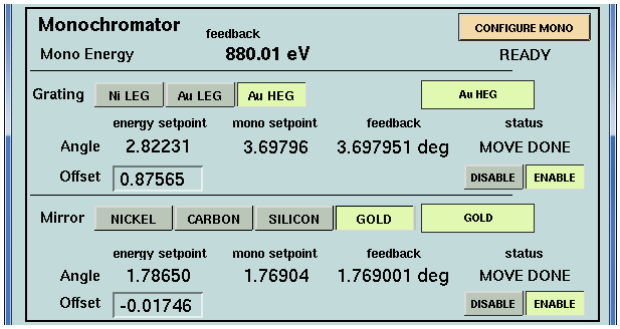
The [Disable/Enable] buttons are used to activate/deactivate individual components.



3.1.5.1 *Selecting Gratings and M2 Coatings*

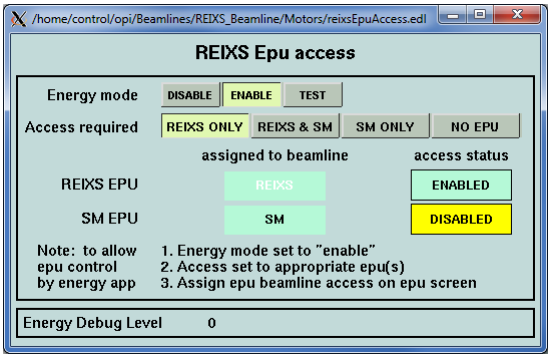
The REIXS monochromator has three gratings. There are four coatings the M2 mirror.

In the "Monochromator" panel, user can select which grating and coating are used. The setpoint and feedback values are also displayed.



3.1.5.2 *Configure EPU Access*

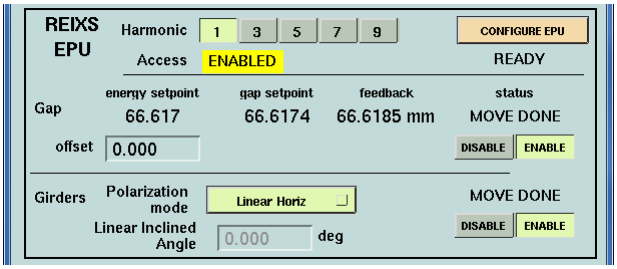
This panel is used to switch EPU access.



Normal mode: [REIXS Only]

2-in-1 mode: [REIXS & SM]

3.1.5.3 *Selecting EPU Harmonics*



Depending on the desired photon energy range, appropriate EPU harmonics shall be selected for optimum flux.

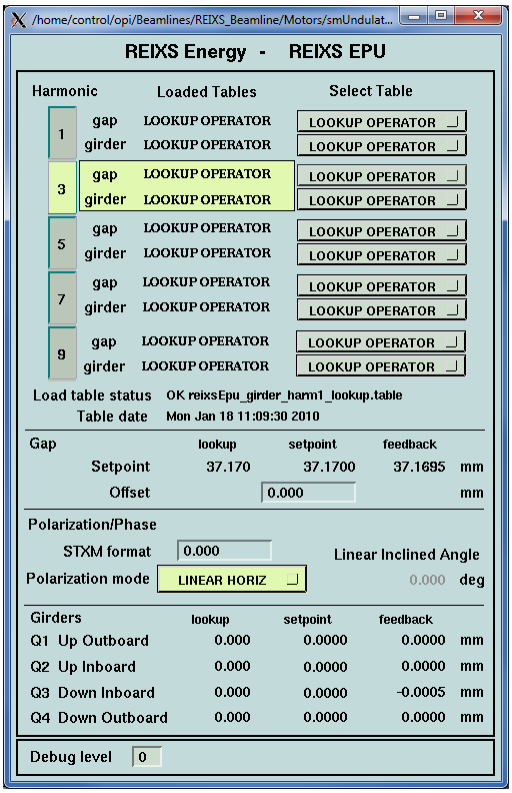
For circular polarization, only the first harmonics can be used.

For linear polarization, use the first harmonics for energy between 80 eV and 1000 eV. Use the third harmonics for energy between 800 eV to 2000 eV. Use the fifth harmonics for energy above 1500 eV.

After executing the command to change EPU harmonics, the EPU does not respond immediately. The EPU harmonics will change the next time energy or polarization is changed.

When the EPU control is established, the "Access" field shows "ENABLED"

3.1.5.4 *Setup EPU Lookup Tables*



The [Configure EPU] button will bring up the panel for loading EPU lookup tables for gap and girder phase control.

Polynomial

3.1.5.5 *Monochromator Parameters*

Clicking [Configure Mono] button will bring up the following panel. In this panel, various monochromator parameters can be configured. This is to be used by beamline staff only.

Grating parameters

Line Density

Position

b2

Grating offset

Mirror Offset

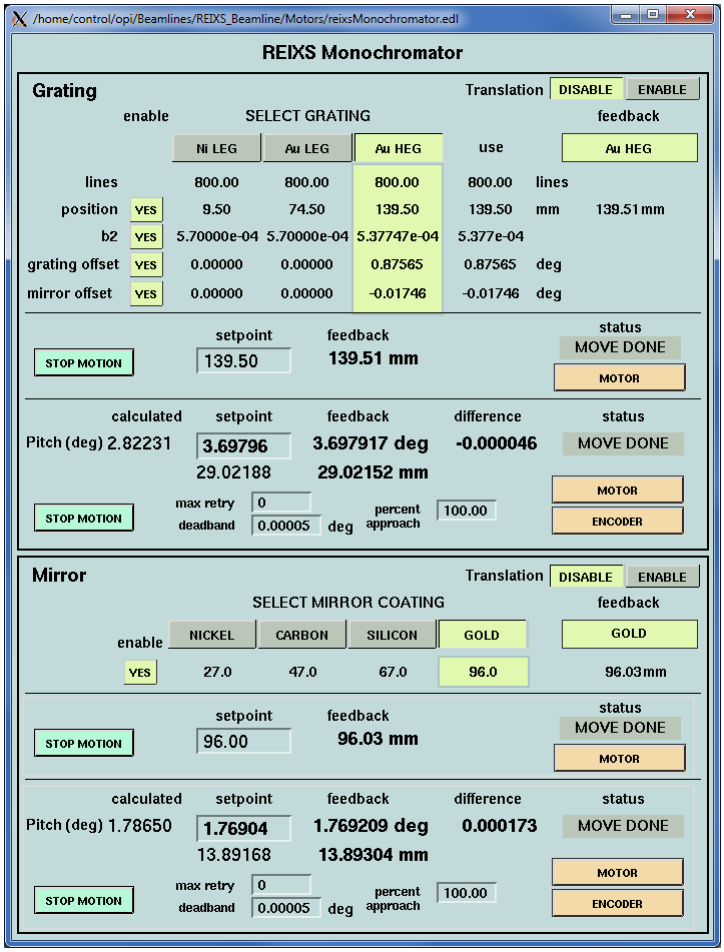
Mirror position

For both grating and mirror

Max retry: 0

Deadband: 0.00005

Percent approach: 100%



3.1.5.6 *IK320 Encoder interface*

For qualified beamline staff only. DO NOT make adjustments without comprehensive knowledge of monochromator control.

For both M2 mirror and Gratings

Sample rate 0.04sec 50Hz

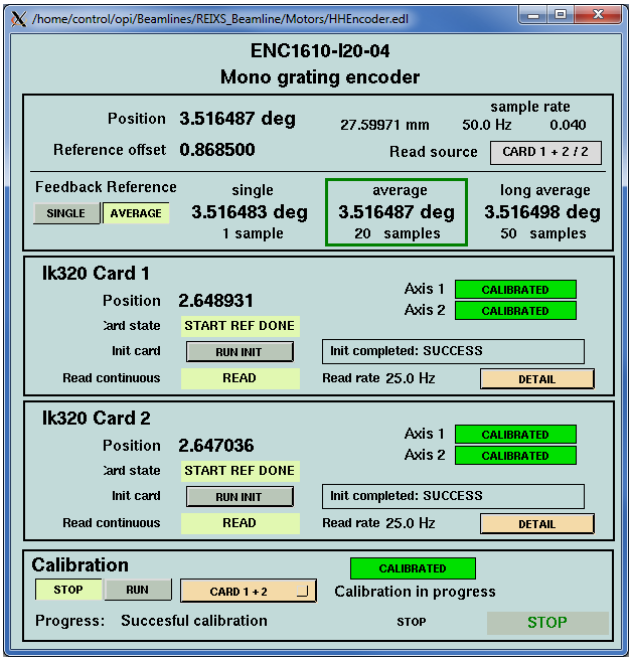
Initialization [Run Init]

"Init completed: SUCCESS"

Calibration

[Card 1 + 2] and [RUN]

"Calibrated" with green background



3.2 Calibrating the Photon Energy

3.2.1 Calibration References

3.2.1.1 *Using Gas cell*

X-ray Photoionization of gas phase

Nitrogen, Neon, Argon, Carbon monoxide or Carbon Dioxide, Oxygen

3.2.1.2 *Solid references*

Through X-ray Absorption Spectroscopy (XAS) of well-defined absorption edges

Metal, Ni, Stainless Steel

Oxides: La edge, Ni edge,

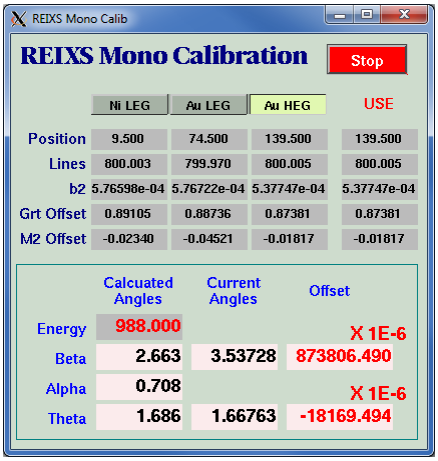
Si, graphite

3.2.2 Tuning the Monochromator Energy Scale

The REIXS Mono Calibration panel is used to fine tune the monochromator calibration.

The calibration needs to be carried out for each grating.

Using a calibration reference with known energy, optimize the flux by adjusting monochromator M2 mirror and grating pitch. Input the known energy into the red "Energy" box. Then input the two red "Offset" values into the corresponding "Grt Offset" and "M2 Offset" boxes. Click the Grating button above this column. The "USE" column will show the current used values. The monochromator is now calibrated to this reference energy.



3.2.3 Tuning the EPU Calibration

To be done only after monochromator calibration.

Needs to be done for each type of polarization.

Scan EPU gap at each energy point.

Using polynomial equations to calculate EPU gap.

4.0 RSXS Endstation Setup

Need to reach UHV. Setup motors. Setup detectors.

4.1 RSXS Endstation Pump Down

RSXS Endstation has several chambers.

4.1.1 Scattering chamber Pump Down

The main scattering chamber has a Pfeiffer Turbo pump and a CTI cryo pump.

Two gate valves

1. Open the gate valve to the turbo pump. If cryo pump is at room temperature, open the gate valve to the cryo pump.
2. Turn on roughing pump.
3. Turn on turbo pump.
4. Turn on ion gauge when the Convection gauge shows 0
5. Turn on cryo pump. The Lakeshore 211 Temperature Monitor shows the cryo pump temperature, ~15K during the normal operation.

4.1.2 Rotary Feedthrough Pump Down

The 2L ion pump on rotary feedthrough needs to be pumped down before start.

1. Close the valve to the main chamber roughing line.
2. Connect a turbo cart to the pumping port for the rotary feedthrough.
3. Open the valve between the first and second stage of the rotary feedthrough.
4. Turn on the turbo cart.
5. When the turbo cart reaches base pressure, turn on the small ion pump.
6. Close the valve between the first and second stage of the rotary feedthrough.
7. Open the valve to the main chamber roughing line.
8. Close the valve to the pumping port for the rotary feedthrough.
9. Stop the turbo cart.

4.1.3 Loadlock Pump Down

Pfeiffer Turbo pump:

1. Close loadlock door. Close gate valve.
2. Turn on roughing pump
3. Turn on turbo pump. The venting valve will close automatically.
4. Turn on ion gauge when the Convection gauge shows 0

4.1.4 Transfer chamber Pump Down

4.2 Setup RSXS Endstation Electronics

NIM Crate and VME Crate

4.2.1 Detectors

Photodiode: connected to Electrometer through a Triax cable

TEY: SR-570 Current Amplifier

Channeltron: Ortec

Micro-Channelplate (MCP):

4.2.2 Scaler Setup

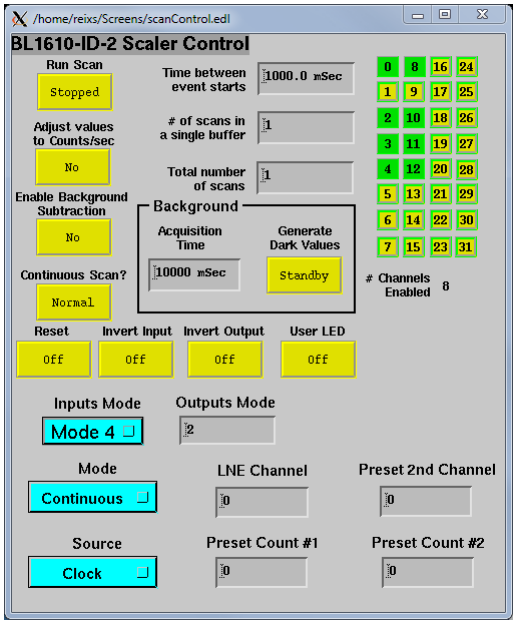
Scaler Setup

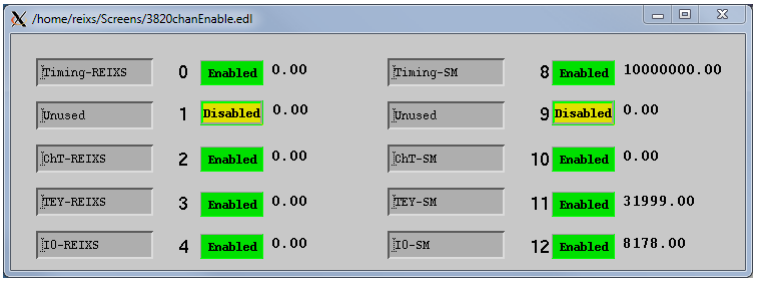
Input Mode: Mode 4

Output Mode: 2

Mode: Continuous

Source: Clock





4.2.3 Temperature Control Setup

Lakeshore 325 Temperature control

Temperature Sensor: Si Diode DT-670

Heater: 25 Ω, 25W max

PID setting

4.3 Setup Motors and SPEC

There are nine AML UHV motors in the chamber

Motor parameters

Temperature monitoring: Omron

4.4 Setup SPEC Control

SPEC control

Config: Motors, Devices, Scalers

Macros: Macro Motors, Macro Hardware, Pre and Post

Polarization, Energy, Temperature

5.0 XES Endstation Setup

5.1 XES Endstation Pump Down

Sample Chamber

Grating Chamber

Detector Chamber

5.2 Setup XES Endstation Electronics

Motion control

Gratings

Microchannel Plate (MCP)

Appendix A: REIXS Beamline Motor Settings

Motor Settings

Appendix B: REIXS Information

[telnet]
telnet ioc1610-201 10000

application	ioc	port	
variableAperture	IOC1610-201	10000	variable aperture for SM and REIXS
reixsMotors	IOC1610-201	10001	motors on REIXS beamline
reixsChopper	IOC1610-201	10002	chopper on REIXS beamline
HHEncoder	IOC1610-201	10003	encoders for REIXS mono
reixsEnergy	IOC1610-201	10004	set up energy on beamline
uofsMotors	IOC1610-201	10011	motors for U of S endstation
apsMotors	IOC1610-201	10021	motors for UBC endstation
picoammeter	IOC1610-108	10000	picoammeters in POE
picoammeter	IOC1610-022	10000	picoammeters along beamline
keithleyMeter	IOC1610-401	10000	REIXS Keithley Meters for RSXS
LakeShore325	IOC1610-401	10001	REIXS Lakeshore Controller for RSXS
SIS3820	IOC1610-403		SIS3820 Scaler for RSXS

[Example]
control@OPI2031-001:181 >telnet ioc1610-201 10002
Trying 10.52.8.2...
Connected to ioc1610-201.cs.clsi.ca (10.52.8.2).
Escape character is '^]'.
@@@ Welcome to the procServ process server (procServ Version 2.4.0)
@@@ Use ^X to kill the child, auto restart is OFF, use ^T to toggle auto restart
@@@ procServ server PID: 29993
@@@ Server startup directory: /etc/rc.d/init.d
@@@ Child startup directory: /iocApps/REIXS_Beamline/IOC1610-201/REIXS_IK320_Encoders
@@@ Child started as: /bin/sh
@@@ Child "/bin/sh" PID: 30749
@@@ procServ server started at: Jul 02, 2009 11:00:56 AM
@@@ Child "/bin/sh" started at: Jul 02, 2009 11:14:15 AM
@@@ 2 user(s) and 0 logger(s) connected (plus you)

^C Kill
^R restart
^] talk to telnet
quit exit telnet

[Clear Registers]

Start up application with VME could run out of registers. Use
/iocApps/vme-commands/clearMaps

Need to logon to IOC1610-201

/iocApps/1100_drv/clearMaps /dev/sis1100_1 0 will clear register (0) for VA application
/iocApps/1100_drv/clearMaps /dev/sis1100_1 1 5 will clear registers (1-5) for reixsMotors application
/iocApps/1100_drv/clearMaps /dev/sis1100_1 6 will clear register (6) for reixsChopper application
/iocApps/1100_drv/clearMaps /dev/sis1100_1 will clear all registers
/iocApps/1100_drv/clearMaps /dev/sis1100_2 will clear all registers for IK320

[Computer ID]
REIXS Main IOC: IOC1610-201
REIXS OPI: OPI1610-201, OPI1610-202
RSXS IOC: IOC1610-403
RSXS Temp: IOC0000-045

Tony's computer: OPI2031-001
/home/wilsont/Epics/Sandbox/epics_local/cs-apps/Beamlines/REIXS_Beamline