

<b>INTERFACE CONTROL DOCUMENT (ICD)</b>	<b>Doc. No. SP-391-001-14 R0</b>	<b>LUSI SUB-SYSTEM CXI</b>
<b>XES PCDS to LUSI CXI Instrument ICD</b>		
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### 1. Applicable Documents

PRD# SP-391-000-19	Physics Requirements for the CXI Instrument
PRD# SP-391-000-03	LUSI Controls and Data System
PRD# SP-391-000-20	CXI Sample Chamber
PRD# SP-391-000-21	CXI Reference Laser System
PRD# SP-391-000-23	LUSI Pulse Picker System
PRD# SP-391-000-24	CXI 0.1 micron Kirkpatrick-Baez (KB) Mirror System
PRD# SP-391-000-25	CXI 1 micron Kirkpatrick-Baez (KB) Mirror System
PRD# SP-391-000-26	CXI Particle Injector System
PRD# SP-391-000-28	CXI Detector Stage
PRD# SP-391-000-30	CXI Ion Time-Of-Flight (TOF)
PRD# SP-391-000-63	CXI Precision Instrument Stand
ESD# SP-391-001-19	LUSI Common Instruments Controls
ESD#SP-391-001-13	CXI Controls ESD
ESD#SP-391-001-18	CXI DAQ ESD

## 2. Introduction

This document defines the interface between the CXI Experiment instrument and the XES Photon Controls and Data Systems. Input for this document comes from the CXI Controls Engineering Specification Document (Controls ESD) and the CXI Data Acquisition Engineering Specification Document (DAQ ESD).

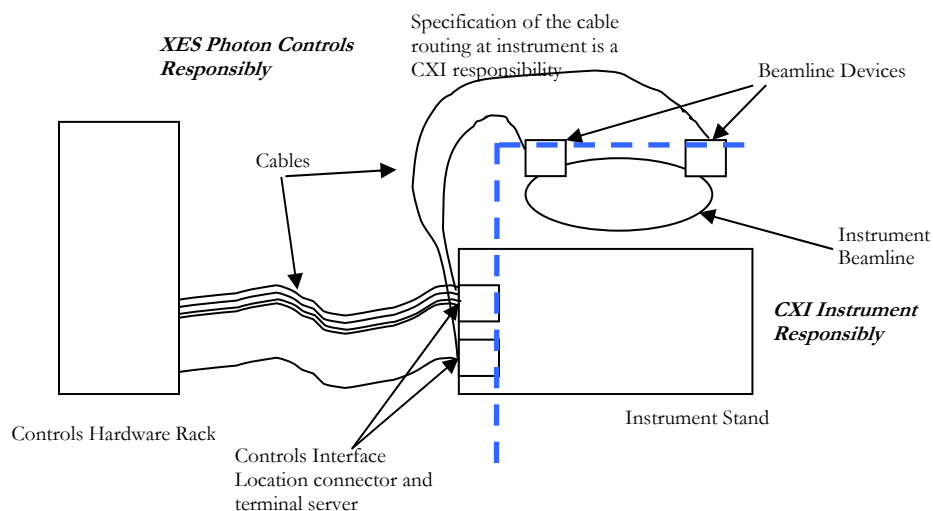
### 2.1. Scope

This document establishes the areas of responsibility for CXI Instrument and XES Photon Controls and defines the interface components. This includes all components for Vacuum, Motion, Vision, DAQ, and Power as well as interfaces to other services including MPS, networking, and timing systems.

### 2.2. Areas of responsibility

In general, the CXI Instrument is responsible for the acquisition and installation of all beam line devices for vacuum, pressure monitoring, motion, vision, and specifying the cable routing from the Controls Interface Location connector to the beam line devices. The Controls/Data Acquisition Group is responsible for the Controls Interface Location connector, all cabling from the Controls Interface Location connector to the controlling hardware (rack based), and is responsible for the acquisition and installation of all non-beamline controls hardware. Controls is also responsible for the procurement and installation of cables from the Interface connector to the beamline devices. For certain components, due to their complexity, the CXI instrument will be responsible for the cabling to the fixed Controls Interface Location connector.

**Figure 2.2.1** Conceptual layout showing areas of responsibility and interface points



### 2.3. Controls Interface Location Connector

The Controls Interface Location connector is a connection point between the Controls/Data Acquisition cabling and the device. This multipurpose connection point (e.g. DIN-rail) is generally located on the experiment stand containing the devices being controlled and read out. In special situations, the Controls Interface Location may be at the particular device itself (e.g. HV power for Ion pumps). For serial controls, the Controls Interface Location connector is an Ethernet connected terminal server located on the instrument stand. The exact location of these interfaces will be jointly determined by the Controls Group and the CXI Instrument during the design stage of the equipment.

## 3. CXI Instrument Control

### 3.1. Instrument packages

#### 3.1.1. Optics Stand 1 in XRT

This instrument package contains the following items from upstream to downstream on the instrument stand (vacuum components discussed in Vacuum Section):

- LUSI Coarse Guard Slit System
- LUSI In-Situ Intensity-Position Monitor
- LUSI Pop-in Profile Monitor

Summary of EPICS control elements:

EPICS Control Group	Device	Model Number	Quantity	Interface Type
Motion	Stepper Motor	<a href="#">Mdrive Plus (smart motor)</a>	8	Serial/ combined with power supply in custom chassis
Power	Power supply for Intensity-Position Monitor Front End Electronics	12 Volt supply	1	NA
Power	Power supply for the stepper motors	SLAC custom built	1	Combined with Serial control interface in custom chassis
Power	Camera	12 Volt supply	1	NA
Vision	Camera	<a href="#">Pulnix TM-1402CL</a>	1	CameraLink
Vision	Zoom lens ( <a href="#">Navitar 1-62523</a> )	SLAC Profile Monitor Controller (TBD)	1	VME w/Acromag IP-445

DAQ	Camera	CameraLink	1	120Hz DAQ Readout
DAQ	Intensity-Position Monitor	SLAC built	1	Serial

### 3.1.2. Optics Stand 2 in XRT

This instrument package contains the following items from upstream to downstream on the instrument stand (vacuum components discussed in Vacuum Section):

- LUSI Attenuator System
- LUSI Pulse Picker

Summary of EPICS control elements:

EPICS Control Group	Device	Model Number	Quantity	Interface Type
Motion	Stepper Motor	<a href="#">Mdrive Plus (smart motor)</a>	2	Serial/ combined with power supply in custom chassis
Motion	Pneumatic positioners	SLAC Solenoid Controller SD-385-001	2	Digital IO to IP digital IO boards on VME cpu
Power	Power supply for the stepper motors	SLAC custom built	1	Combined with Serial control interface in custom chassis
Power	Pulse Picker	TTL Pulser	1	EVR

### 3.1.3. Optics Stand 3 in XRT

This instrument package contains the following items from upstream to downstream on the instrument stand (vacuum components discussed in Vacuum Section):

- LUSI Coarse Guard Slit System
- LUSI Pop-in Intensity Monitor
- LUSI Pop-in Profile Monitor

Summary of EPICS control elements:

EPICS Control Group	Device	Model Number	Quantity	Interface Type
Motion	Stepper Motor	<a href="#">Mdrive Plus (smart motor)</a>	6	Serial/ combined with power supply in custom chassis
Power	Power supply for Intensity Monitor Front End	12 Volt supply	1	NA

Electronics				
Power	Power supply for the stepper motors	SLAC custom built	1	Combined with Serial control interface in custom chassis
Power	Camera	12 Volt supply	1	NA
Vision	Camera	<a href="#">Pulnix TM-1402CL</a>	1	CameraLink
Vision	Zoom lens ( <a href="#">Navitar 1-62523</a> )	SLAC Profile Monitor Controller (TBD)	1	VME w/Acromag IP-445
DAQ	Camera	CameraLink	1	120Hz DAQ Readout
DAQ	Intensity Monitor	SLAC built	1	Serial

### 3.1.4. Laser Stand in XRT

This instrument package contains the following items from upstream to downstream on the instrument stand (vacuum components discussed in Vacuum Section):

CXI Reference Laser

Summary of EPICS control elements:

EPICS Control Group	Device	Model Number	Quantity	Interface Type
Motion	Stepper Motor	<a href="#">Mdrive Plus (smart motor)</a>	1	Serial/ combined with power supply in custom chassis
Motion	Picomotors (TBD)	TBD	2	Serial (TBD)
Power	Power supply for the stepper motors	SLAC custom built	1	Combined with Serial control interface in custom chassis

### 3.1.5. Optics Stand 4 in FEH Hutch 5

This instrument package contains the following items from upstream to downstream on the instrument stand (vacuum components discussed in Vacuum Section):

LUSI Coarse Guard Slit System

LUSI In-Situ Intensity-Position Monitor

LUSI Pop-in Profile Monitor

Summary of EPICS control elements:

EPICS Control Group	Device	Model Number	Quantity	Interface Type
Motion	Stepper Motor	<a href="#">Mdrive Plus (smart motor)</a>	8	Serial/ combined with power supply in custom chassis
Power	Power supply for Intensity-Position Monitor Front End Electronics	12 Volt supply	1	NA
Power	Power supply for the stepper motors	SLAC custom built	1	Combined with Serial control interface in custom chassis
Power	Camera	12 Volt supply	1	NA
Vision	Camera	<a href="#">Pulnix TM-1402CL</a>	1	CameraLink
Vision	Zoom lens ( <a href="#">Navitar 1-62523</a> )	SLAC Profile Monitor Controller (TBD)	1	VME w/Acromag IP-445
DAQ	Camera	CameraLink	1	120Hz DAQ Readout
DAQ	Intensity-Position Monitor	SLAC built	1	Serial

**3.1.6. Mirror Stand in FEH Hutch 5**

This instrument package contains the following items from upstream to downstream on the instrument stand (vacuum components discussed in Vacuum Section):

CXI 1 Micron KB Mirrors

Summary of EPICS control elements:

EPICS Control Group	Device	Model Number	Quantity	Interface Type
Motion	Stepper Motor (stage)	<a href="#">Mdrive Plus (smart motor)</a>	5	Serial/ combined with power supply in custom chassis
Motion	PicoMotors (mirror alignment)	JTEC TBD	10	Serial (TBD)

Motion	Autocollimator	JTEC JM1000-AC	1	Serial (TBD)
Power	Power supply for the stepper motors	SLAC custom built	1	Combined with Serial control interface in custom chassis

### 3.1.7. Optics Stand 5 in FEH Hutch 5

This instrument package contains the following items from upstream to downstream on the instrument stand (vacuum components discussed in Vacuum Section):

- LUSI Coarse Guard Slit System
- LUSI Pop-in Intensity Monitor
- LUSI Pop-in Profile Monitor

Summary of EPICS control elements:

EPICS Control Group	Device	Model Number	Quantity	Interface Type
Motion	Stepper Motor	<a href="#">Mdrive Plus (smart motor)</a>	6	Serial/ combined with power supply in custom chassis
Power	Power supply for Intensity Monitor Front End Electronics	12 Volt supply	1	NA
Power	Power supply for the stepper motors	SLAC custom built	1	Combined with Serial control interface in custom chassis
Power	Camera	12 Volt supply	1	NA
Vision	Camera	<a href="#">Pulnix TM-1402CL</a>	1	CameraLink
Vision	Zoom lens ( <a href="#">Navitar 1-62523</a> )	SLAC Profile Monitor Controller (TBD)	1	VME w/Acromag IP-445
DAQ	Camera	CameraLink	1	120Hz DAQ Readout
DAQ	Intensity Monitor	SLAC built	1	Serial



### 3.1.8. CXI Precision Instrument Stand in FEH Hutch 5

This instrument package contains the following items from upstream to downstream on the instrument stand (vacuum components discussed in Vacuum Section):

- CXI Precision Instrument Stand
- CXI 0.1 Micron KB Mirrors
- CXI Sample Chamber
- CXI Particle Injector System
- CXI Ion TOF
- CXI Detector Stage

Summary of EPICS control elements:

EPICS Control Group	Device	Model Number	Quantity	Interface Type
Motion	Stepper Motor	<a href="#">Mdrive Plus (smart motor)</a>	20 + 1 controller only	Serial/ combined with power supply in custom chassis
Motion	Custom motors in sample chamber	Various (see 3.1.2 and 3.1.5)	32	Serial (TBD)
Power	Power supply for the stepper motors	SLAC custom built	2	Combined with Serial control interface in custom chassis
Power	ION TOF DC	ISEG VHS4050X_105	2	VME
Power	ION TOF HV Pulser	IXYS PVX-4140	2	Trigger from EVR
Power	PhotoDiode in Detector Stage	TBD	1	TBD (VME)
Power	Power supply for the stepper motors	SLAC custom built	1	Combined with Serial control interface in custom chassis
Power	Camera	12 Volt supply	1	NA
Vision	Camera	Pulnix TM-6760CL and TM-1402CL	4	CameraLink Non-DAQ
Vision	Telescope	Questar QM1	1	TBD (serial?)
Vision	Zoom lens ( <a href="#">Navitar 1-62523</a> )	SLAC Profile Monitor Controller (TBD)	3	VME w/Acromag IP-445

Vision	Illuminators	Edmund Optics NT55-232 with NT57-783	3	Serial
Miscellaneous	Particle Injector Components	See Sec. 3.1.6	8	Serial and TBD
	Camera	CameraLink	1	Non-DAQ readout
DAQ	Waveform Digitizer	Acqiris	4	cPCI
DAQ	Cornell Detector	SLAC built	1	Serial

### 3.1.9. Diagnostics Stage in FEH Hutch 5

This instrument package contains the following items from upstream to downstream on the instrument stand (vacuum components discussed in Vacuum Section):

- LUSI In-Situ Intensity-Position Monitor
- LUSI Pop-in Profile Monitor with high resolution option

Summary of EPICS control elements:

EPICS Control Group	Device	Model Number	Quantity	Interface Type
Motion	Stepper Motor	<a href="#">Mdrive Plus (smart motor)</a>	5	Serial/ combined with power supply in custom chassis
Power	Power supply for Intensity-Position Monitor Front End Electronics	12 Volt supply	1	NA
Power	Power supply for the stepper motors	SLAC custom built	1	Combined with Serial control interface in custom chassis
Power	Camera	12 Volt supply	1	NA
Vision	Camera	<a href="#">Pulnix TM-6710CL</a> or <a href="#">Imperx IPX-VGA210</a>	1	CameraLink
DAQ	Camera	CameraLink	1	120Hz DAQ Readout
DAQ	Intensity-Position Monitor	SLAC built	1	Serial

### 3.1.10. CXI Vacuum System

Component	Device	Model Number	Quantity	Interface Type
<b>X-Ray Transport Tunnel Vacuum</b>	Gate Valve	VAT Series 108 (pneumatic controller)	5	PLC controlled
	Ion Pumps	<a href="#">Gamma Vacuum TiTan100L</a> with <a href="#">Digitel MPS Controller</a>	4 pumps, 2 controllers	Serial
	Cold Cathode Gauges and TBD Pirani Gauges	MKS with MKS 937A Gauge Controller	4	Serial
<b>FEH Hutch 4</b>	Ion Pumps	<a href="#">Gamma Vacuum TiTan100L</a> with <a href="#">Digitel MPS Controller</a>	1 pumps, 1 controllers	Serial
	Cold Cathode Gauges and TBD Pirani Gauges	MKS with MKS 937A Gauge Controller	1	Serial
	Gate Valve	VAT Series 108 (pneumatic controller)	8	PLC controlled
<b>FEH Hutch 5</b>	Ion Pumps	<a href="#">Gamma Vacuum TiTan100L</a> with <a href="#">Digitel MPS Controller</a>	3 pumps, 2 controllers	Serial
	Cold Cathode Gauges and TBD Pirani Gauges	MKS with MKS 937A Gauge Controller	7	Serial
	Turbo Pumps with backing pumps	Varian V551 with TriScroll 300 backing pump. Varian Turbo-V 550 controller	3	Serial
	Turbo Pump	Varian V81M with Turbo-V 550 Controller	1	Serial
<b>CXI Sample Chamber / Particle Injector</b>	Backing Pump	TriScroll PTS03001UNIV	2	Remote on/off

## 4. Other Systems

### 4.1. Global Monitoring

The Controls Group will provide global monitoring capabilities, including hutch temperature, and general webcam viewing, as well as for temperature and cooling system monitoring sensitive instrument components.

### 4.2. XTOD Vacuum System

An interface exists between the CXI Instrument vacuum system and the XTOD vacuum system in the XRT. The XTOD vacuum system controller needs a VAC OK/VAC NOT OK signal from the CXI Instrument Vacuum system. This will be provided by using the vacuum trip output from the appropriate pressure gauges on various CXI instrument stands. Controls will implement a repeater relay on the Controls Interface Location connector at these stands to route this signal to the XTOD vacuum system controller.

### 4.3. Machine Protection System

A VALVE NOT OUT signal will be provided to the Machine Protection System for each gate valve on the CXI beam line. This signal, taken from the Valve Out position indicator on the gate valve will be routed to the MPS system via the Controls Interface Location connector on the instrument stand, Controls to implement. Controls will implement this signal.

### 4.4. AC Power

AC Power will be provided at each instrument stand location. Two 30 Amp circuits with Quad distribution boxes will be provided at the location of each instrument stand as listed in section 3 above. Each PCDS rack will be equipped with two separate 3 phase, 208VAC, 30 Amp circuits.

### 4.5. Machine Timing

Several devices require precise triggering with respect to the FEL pulse. As noted in the tables above, this timing comes from the Controls system via equipment (EVRs) in the support racks.