# HXS Operating Procedures

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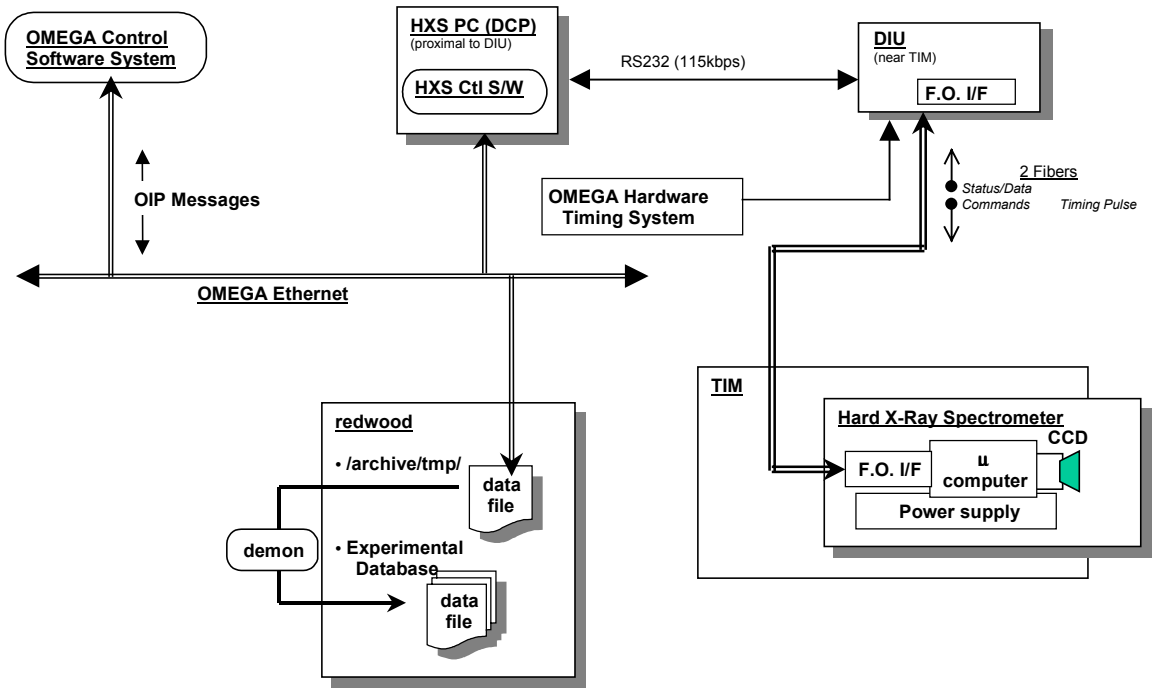
## Instrument Overview

The Hard X-Ray Spectrometer (HXS) is an instrument, fielded in a TIM at the OMEGA laser facility, whose purpose is to record the hot-electron Bremsstrahlung energy distribution in the x-ray energy range 12 to 60 keV region (see Figure 1). The spectrometer is an adaptation of a compact and robust instrument that was originally developed at NIST for the energy calibration of medical radiography x-ray sources. The spectrometer is composed of a cylindrically bent crystal, slit, scatter shielding, and a detector plane that is compatible with a CCD camera or a streak camera (see Figure 2). The CCD x-ray detector provided with the instrument is detachable so that an LLE streak camera can be mounted for the purpose of recording time-resolved spectra. Based on preliminary sensitivity tests of a prototype spectrometer and the expected hard x-ray flux from OMEGA targets, well-exposed spectra can be recorded on the CCD on a single laser shot.

<< fig 1: insert picture of the HXS setup in a bench-test configuration >>

<< fig 2: insert mechanical drawing of the instrument >>

The HXS has support hardware in order to interface to the OMEGA data system (see Figure 1). The hardware consists of a Diagnostic Control Processor (DCP) and a Diagnostic Interface Unit (DIU). In addition the Battery Recharge Interface Control Keeper (BRICK) is used to charge the Internal Battery Pack (IBP) when in an offline configuration. The following diagram details how the HXS system interfaces with the OMEGA system.




In general, the OMEGA system controls the instrument by interfacing to the DCP. The DCP will respond with self-test status and data collected from the instrument. The DCP handles all control of the instrument via the DIU using the HXS control protocol (which is out of the scope of this document). This control is effected via the data fiber optic link. The DCP will instruct the instrument to prepare for the shot, perform self-tests, set control parameters, and request data. The actual timing of the CCD integration cycle is keyed from the timing pulse received on the BNC connector at T-10 seconds. The instrument will generate timing signals at T-delta to begin CCD integration and T+epsilon to terminate CCD integration. Delta and Epsilon are configurable parameters. The instrument data will be sent to the OMEGA system in a TBD format.

## Operation Overview

- See the **Static Test Plan** document for bench testing
- Software Revision levels will be reported in Self-Test data
- Communication with the instrument must occur at least every 11.5 hours. If more than 12 hours passes the instrument will enter a shutdown mode, which require the 25pin battery connector to be remove and reinstalled to resume operation
- Instrument enters the ready state on command from OMEGA and automatically goes into dormant state when data transfer is complete
- If needed the DCP contains a GUI control program which can be used to control the instrument in case of communication failure with OMEGA
- Full instrument shutdown is accomplished by disconnecting the battery pack and shutting down the DCP

**Critical Data**

| Item | Interface | HXS Supplied Interface Connection/Parameters |
|---|---|---|
| DCP | | |
| | Power | Standard 110VAC |
| | Network | 10Base-T |
| | Serial | RS-232 via 9Pin female D-Sub<br>115.2 kbps<br>HXS control protocol |
| DIU | | |
| | Power | Standard 110VAC |
| | Timing Trigger | Female BNC – 50 Ohm Line Impedance<br>250ns high-going pulse at T-10 |
| | Serial | RS-232 via 9Pin D-Sub<br>115.2 kbps<br>HXS control protocol |
| | Data Fiber | SMA – tbd micron<br>ACS102A Optical Modem protocol |
| | Timing Fiber | SMA – tbd micron<br>tbd protocol |
| BRICK | | |
| | Power | Standard 110VAC (combined with DIU power) |
| | Battery Connection | 25Pin D-Sub |

**Detailed Procedures:**

***Pre-Installation Checks***

**Intent:**
This procedure is to be used prior to installing the HXS instrument. A copy of the attached checklist shall be filled in as the procedure is executed and provided to the ESO when the process is complete.

**Prerequisites:**
The HXS instrument is to be entered into general operations.

**Procedure:** (Perform steps in the order listed.)

1) Open the HXS instrument shipping container ❑

   << insert picture of the open shipping container (full with subtitles) >>

2) Verify that the DCP laptop carrying case is present ❑

3) Verify that the DIU/BRICK box is present ❑

4) Verify that the DIU/BRICK AC/DC Adapter is present ❑

5) Verify that the HXS instrument assembly is present ❑

6) Remove the items and perform a bench-test per the **Static Test Plan** ❑

Date/Time _____

Operator _____

*Installation*

**Intent:**
This procedure is to be used in order to install the HXS instrument. A copy of the attached checklist shall be filled in as the procedure is executed and provided to the ESO when the process is complete.

**Prerequisites:**
The Pre-Installation procedure must be completed.

**Procedure:** (Perform steps in the order listed.)

7) Setup the DCP laptop ❑

   I. ?? Place the laptop somewhere??

   << show visual of laptop installed >>

8) Plug the DCP Laptop AC/DC converter into the laptop ❑

   << show picture of laptop DC plug installed >>

9) Plug the DCP laptop AC/DC converter into a powered 110VAC outlet ❑

10 Connect the 10Base-T cable to the ethernet interface on the laptop and to the LLE ethernet (wall or hub) ❑

11 Setup the DIU/BRICK ❑

   I. The DIU/BRICK is installed next to the DCP laptop

   << show picture of DIU setup next to the laptop>>

12 Plug the DIU/BRICK AC/DC converter into the laptop ❑

   << show picture of DC plug installed >>

13 Plug the DIU/BRICK AC/DC converter into a powered 110VAC outlet ❑

14 Connect the 9Pin RS-232 cable to the Laptop and the DIU ❑

   I. The male end of the cable plugs into the laptop

   II. The female end of the cable plugs into the DIU

   << show a picture of the installed cable>>

15 Connect the BNC Timing cable to the DIU ❑

   << show a picture of the cable installed>>

16 Install the assembled HXS instrument into the TIM boat ❑

   The assembled spectrometer and TIM Interface Plate (TIP) attaches to the TIM boat with tooling balls and spring loaded captive 10-32 PEM hardware.

   << insert picture of the installed instrument >>

17 Install the vacuum-side Data Fiber-Optic between the TIM boat connector block assembly and the DE F/O Data Port ❑

I. The TIP SMA fiber optic connectors are located on the topside of the Drive Electronics (DE).

II. The LLE Fiducial F/O SMA functions as the HXS data fiber optic.

III. The cable is routed through the opening in the handles of the DE

<< insert picture of mated data connector with trigger connector open >>

18 Install the vacuum-side Trigger Fiber-Optic between the TIM boat connector block assembly and the DE F/O Trigger Port ❑

I. The TIP SMA fiber optic connectors are located on the topside of the Drive Electronics (DE).

II. The LLE OTIS F/O SMA functions as the HXS trigger fiber optic.

III. The cable is routed through the opening in the handles of the DE

<< insert picture of the mated trigger connector w/ relation to data >>

19 Insert the mating Parker dry connectors from the TIP structure ❑

I. The tubes are routed through the opening in the handles of the IBP

<< insert picture of the mated Parker connectors >>

20 Connect the atmosphere-side SMA fiber optic Jack cables to the DIU ❑

I. The LLE OTIS F/O SMA functions as the trigger fiber optic

II. The LLE Fiducial F/O SMA functions as the HXS data fiber optic

<< show a picture of connectors mated>>

21 Power up the DIU/BRICK. Verify the Power indicator is illuminated ❑

I. Move the power switch located on the front right of the box to the “On” position

II. The power indicator is immediately next to the power switch

<< show a picture of the DIU/BRICK powered>>

22 Connect the Internal Battery Pack to the 25pin D-Sub connector on the DIU/BRICK. Verify that the charging indicator is illuminated ❑

I. The 25pin connector is on the back of the DIU/BRICK

II. The charging indicator is on the front-right of the DIU/BRICK

III. The charging indicator may take several seconds to illuminate

<< show a picture of the connector position>>

<< show a picture of the battery charging>>

23 Leave the system in this configuration for at least 12 hours ❑

Start Date/Time _____ End Date/Time _____

24 Turn on the DCP laptop ❑

Wait for Windows98 to boot-up. This may take several minutes.

25 Double-click on the "DCP Omega Interface" icon in the middle of the desktop ❑

I. The DCP program will start. This may take a few minutes.

II. When the program is ready, it will display a status message saying that the system is okay (in a dialog box). Record the software version number displayed in the dialog box

Software Version _____

Click "Okay" to dismiss the dialog box.

26 Conduct the LLE DAS system test of the HXS instrument. ❑

27 Conduct the CCD aliveness test as discussed in the HXS Static Test Plan document. Proceed if the test image is acquired. ❑

28 Verify that all cables are safely routed inside the TIM space envelope and that the 37 pin D-sub connector RF cover is installed. ❑

Date/Time _____

Operator _____

***Operation***

set-up sheet, instructions, check list
pre-shot operational check
shot operation
post shot checks/recovers
securing from shots

**Intent:**
This procedure is to be used in order to operate the HXS instrument. A copy of the attached checklist shall be filled in as the procedure is executed and provided to the ESO when the process is complete.

**Prerequisites:**
The HXS Installation procedure must be completed.

**Procedure:** (Perform steps in the order listed.)

29 This section is TBD . ❑

***Removal and Storage***

**Intent:**
This procedure is to be used to shutdown, remove, and store the HXS instrument for a significant duration. A copy of the attached checklist shall be filled in as the procedure is executed and provided to the ESO when the process is complete.

**Prerequisites:**
The HXS instrument is to be removed from general operations.

**Procedure:** (Perform steps in the order listed.)

30 Exit the DCP OMEGA interface program ❑

In the lower right corner of the interface program's main screen is a button marked 'Quit'. Click on this button. Click the 'Yes' button when prompted for confirmation.

<< insert picture of interface program's main screen >>

31 Power off the DCP ❑

Shutdown the Windows PC via the shutdown feature located under the start menu. The laptop will power itself off.

32 Unplug the DCP AC/DC converter three-prong power connector from the wall outlet. ❑

33 Unplug the DCP 10Base-T connector from the laptop and from the wall ❑

34 Unplug the 9Pin RS-232 cable from the DCP laptop ❑

35 Put the DCP laptop, the 10Base-T cable, and the AC/DC converter into the laptop carrying case. ❑

36 Power off the DIU/BRICK ❑

On the front left of the DIU/BRICK is a power switch. Move the switch to the 'Off' position.

<< insert picture of front of DIU/BRICK >>

37 Unplug the DIU/BRICK AC/DC converter three-prong power connector from the wall outlet ❑

38 Unplug the DIU/BRICK AC/DC converter from the DIU/BRICK chassis ❑

<< insert picture of the power connection to the DIU/BRICK >>

39 Unplug the 9Pin RS-232 cable from the DIU ❑

<< insert picture of the connector being removed>>

40 Unplug the Trigger and Data fiber optic cables from the DIU ❑

<< insert picture of the connectors being removed>>

41 Unplug the BNC timing cable from the DIU ❑

<< insert picture of the connector being removed>>

42 Place the DIU/BRICK, the DIU/BRICK power adapter and cables, and the laptop carrying case into the HXS instrument shipping case ❑

<< insert picture of the items in the shipping case >>

43 Retract the HXS instrument and open the TIM cover ❑

<< insert picture of TIM with cover off >>

44 Disconnect the IBP 25pin connector from the DE ❑

<< insert picture of 25 pin connector being removed >>

45 Disconnect the two vacuum-side SMA fiber optic Jack cables ❑

<< insert picture of SMA connectors being removed >>

46 Install dust covers on the two atmosphere-side SMA fiber optic Jack conectors ❑

47 Disconnect the mating Parker dry connectors from the TIP structure ❑

<< insert picture of Parker connectors being removed >>

48 Remove the instrument from the TIM and place it in the shipping container ❑

The assembled spectrometer and TIM Interface Plate (TIP) attaches to the TIM boat with tooling balls and spring loaded captive 10-32 PEM hardware.

<< insert picture of instrument in the shipping container >>

49 Close and latch the shipping container ❑

Date/Time _____

Operator _____