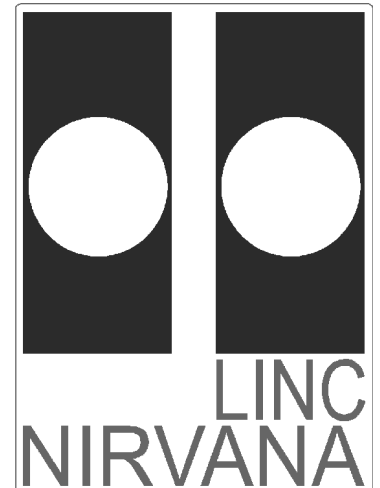


# LINC-NIRVANA

The **L**BT **I**nterferometric **C**amera and  
**N**ear-**I**nfra**R**ed / **V**isible **A**daptive  
**i**nterferometer for **A**stronomy

A collaborative project of the MPIA Heidelberg, INAF-Arcetri,  
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## LINC-NIRVANA

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### Instrument Control Electronics - MHWS

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Prepared	<u>I. Mohr</u> .....	<u>19 January 2005</u> .....	
	Name	Date	Signature
Approved	<u>J. Farinato</u> .....	<u>17 February 2005</u> .....	
	Name	Date	Signature
Released	<u>K. Kürster</u> .....	<u>20 May 2005</u> .....	
	Name	Date	Signature

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## 1 Scope

This document describes the control electronics and the CCD read-out electronics for the Mid-High Layer Wavefront Sensor.

## 2 Applicable documents

No.	Title	Number & Issue
1	FDR Instrument Control Electronics - Bench	LN-MPIA-FDR-ELEC-002

## 3 External Interfaces

Item	Short description

## 4 Acronyms and abbreviations

MHWS	Mid-High Layer Wavefront Sensor
CCD	Charge Coupled Device
DIN	Deutsches Institut für Normung (German Institute for Standardization)
VDE	Verband der Elektrotechnik (Association for Electrical)
PI	Physik Instrumente (German company, <a href="http://www.pi.ws">www.pi.ws</a> )

## 5 Introduction

The electronics part of the MHWS consists of the motor controller, CCD system, and cabling. The two MHWS towers include thirty-eight motors (nineteen motors per side), two CCD systems and their cables (one CCD system per side).

## 6 Functions

- § Motor Controller
- § CCD camera (CCD39)
- § Cabling

## 7 Motor Controller

### 7.1 Purpose

With the MHWS, 32 linear stages (custom designed by PI) will be used (16 in each arm) to position the 8 star enlargers of the two MHWS in the field. Two commercial PI linear stages will be used to focus the 2 CCDs (one for each arm), and two commercial PI linear stages will be used to switch between the mirror and the beam splitter in the patrol camera system (one for each arm). Finally two rotational stages will be used for the K-mirror rotation (one for each arm).

### 7.2 Requirements

The controller has to support:

- Incremental encoder
- Parallel movement
- Remotely ramped parameters loadable from the host
- Limit switches
- Reference switch.

Furthermore, the motor system should be able to power off all active parts which can have heat dissipation.

The following list shows the required motor hardware:

No.	Motor type	Limit sw.	Ref. sw.	Pos. sw.	Inc. enc.	Abs. enc.	Description
32	servo	x	x	-	x	-	x-y stages Type: M-505K023
2	servo	x	x	-	x	-	Focus stages Type: M-405.CG
2	servo	x	x	-	x	-	Patrol camera stages Type: M-521.DG
2	servo	x	x	-	x	-	K mirror rotational stages Type: 2232 012SR

Table 7-1: Motor hardware requirements for the MHWS

### 7.3 Parts

- 6 motor systems with a SigAmp amplifier (refer to LN-MPIA-FDR-ELEC-002)
- 6 patch-boxes (refer to section on cabling below)

## **7.4 Layout**

The MHWS need four motor controller 19" units, two units for each side. The racks for the left and right side are identical. The first 19" unit includes two motor systems. These are necessary for the x-y stages with support for incremental encoder, limit, and reference switches. One motor system is needed for the focus, patrol camera, K mirror rotational stages.

## **7.5 Functionality**

Each motor system is able to switch off all consumers (motor, incremental encoder and limit switches) to reduce heat dissipation. For a detailed interface description, refer to MoCon programmer's guide documentation.

## **7.6 Capability**

The control signals for the activeDrive stages are boosted to extend the cable length. This is done with the SigAmp amplifier board.

## **7.7 Availability**

This is not time critical. All the components should be available within 3 months.

## 8 CCD camera (CCD39)

### 8.1 Purpose

The CCD cameras are detectors for the wavefront sensors. The images have to be processed in “real-time”. Fast and low noise CCDs are used.

### 8.2 Requirements

The requirements for the CCD are:

- Read out speed:  $\geq 1\text{kHz}$  14bit
- Read out noise:  $< 6e-$  @500Hz frame rate
- Dark noise:  $< 1e-$  @10ns exposure time for ambient temperature -15 to +25
- Cooling: Peltier cooled (-40C) with liquid cooling to take heat away
- Badpix:  $\leq$ over all (grade 1, better grade 0)
- Coating. Midband (E2V band specs) @E ~ 80% @600nm, F/1 antireflecting coating

### 8.3 Parts

- CCD SciMeasure Controllers (19” units)
- CCD SciMeasure head



## 9 Cabling

### 9.1 Purpose

There will be cabling of the MHWS unit as well as the connection between the MHWS and the electronic cabinets. Here, we will focus on the connection between cabinets, K-mirror and patchbox.

### 9.2 Requirements

The cable layout and routing of the bench control electronics is implemented according to DIN and VDE rules. The following aspects will be regarded for good cabling design:

- The length of cables will be minimized
- Cables carrying signals of different strength will be separated
- Cables will be twisted or at least bundled
- All parts will be mechanically fixed in a way to avoid damage by wear and tear

Each cable should have a unique number, which identifies it. All cables will be labeled in the same way. The cabling from moving parts should have a special cable which is specified for that. Each part which will be connected has to be removable.

Different voltage levels on the grounding line and grounding loops have to be avoided. It shouldn't be possible to connect wrong parts by cabling, if there is the risk to damage one of the parts..

### 9.3 Parts

- 6 x "PI -Patchbox"
- Military connectors (Mil)
  - Limit-Switch: PT series 26 pins -> 6 x Male / 6 x Female
  - Incremental Encoder: PT series 55 pins -> 6 x Male / 6 x Female
  - Motor Power: PT series 6 pins -> 4 x Male / 4 x Female (for activeDrive)
  - Motor PWM signals: PT series 19 pins -> 4 x Male / 4 x Female (for activeDrive)
  - Motor signals: PT series 32 pins -> 2 x Male / 2 x Female (for standard servo)
- D-Sub connectors (for PI-stage cables)
  - 48 x D-SUB 15 Male
  - 48 x D-SUB 15 Female
- TINI Q-G Miniature Switchcraft connectors (for PI-stage cables)
  - 32 x TINI Q-G 3P Male
  - 32 x TINI Q-G 3P Female
- Cables

## 9.4 Layout

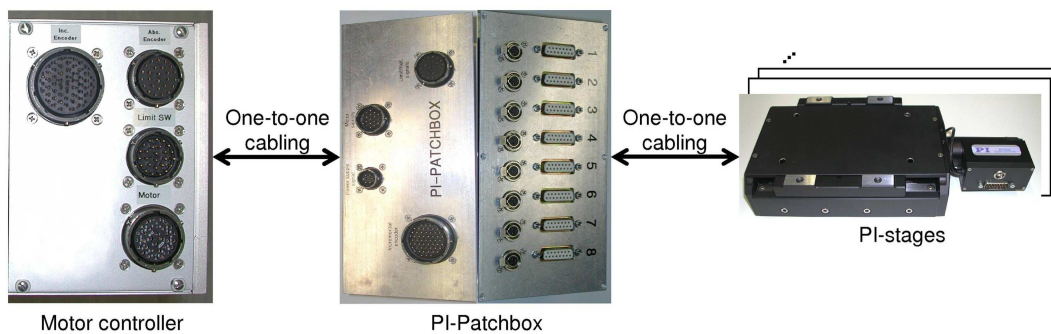


Figure 9-1: Schematic diagram of the motor cabling

## 9.5 Functionality

The cables which come from the motor controllers are arranged by functionality (incremental encoder, limit signals,...). After the patchbox, the cable is organized by motor units. The CCD cable bundle is composed of four signal cables (coax), one data cable, and one clock cable.

## 9.6 Specification

The cable length for the motor systems should not exceed 10 meters. For the CCD, the cable length should not exceed 6 meters.