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Organisation Européenne pour des Recherches Astronomiques dans l'Hémisphère Austral
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LA SILLA-PARANAL OBSERVATORY

HARPS HIGH EFFICIENCY FIBER SHUTTER ELECTRONICS

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CHANGE RECORD

Revision	Date	Section/Paragraph	Remarks
Issue 1.0	24/12/2004	All	First Issue
Issue 1.1	14/05/2005	Several	Update after prototype test. Schematic diagrams update. Signal names added to cables schematics. (FDR) Acronyms added. (FDR) VME interface.

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1. INTRODUCTION

The High Accuracy Radial-velocity Planetary Searcher (HARPS) is designed for precise

Radial Velocity (RV) measurements. Unfortunately the required extreme stability is achieved, among other factors, at expenses of the instrument's optical efficiency. Because the RV precision depends not only on the number of photons but also on the spectral resolution, the projected diameter of the fibre on the sky is only 1 arcsec, yielding a spectral resolution of 110000. An image scrambler for the stabilization of the input beam is also needed; the image scrambler alone is responsible for a 25% loss in efficiency.

The shutter in the standard HARPS mode (HAM: High Accuracy Mode) is located just upstream of the scrambler, outside of the vacuum vessel. This is not an option for the High Efficiency Mode (HEM, see [AP1]).

High Efficiency Fibres (HEF) with larger field of view (1.4 arcsec) and without scrambler are installed in parallel to the standard fibres within the spectrograph, but have not been connected to the fibre adapter. The responsibility of installing the fibre in their metallic jacket, manufacture a shutter and a fibre head was left to ESO.

The main challenge is to develop a fibre head integrating a shutter and taking into consideration a micro-lens design for the fibre input. Other design tasks involve the shutter control hardware and the modification of the ICS/OS/templates, and the data reduction SW. Please refer to [AP1] "High Efficiency Mode Upgrade: Users Requirement and Implementation Plan".

The 3P6 HARPS Cassegrain Fibre Adapter (HCFA) incorporates a fibre head carriage for two units, actually two heads are installed; one for the High Accuracy Mode (HAM) of the HARPS Spectrograph and the other for the Coude Echelle Spectrograph (CES). According to the requirements [AP1] the new HARPS High Efficiency Mode (HEM) head will be installed in the CES head place and it will be changed whenever the CES is needed, thus not requiring to dismount the HAM head.

1.1. PURPOSE AND SCOPE

This document presents a possible design for the High Efficiency Fiber Shutter (HEFS) control electronics. Starting with a block diagram it goes all the way down to the circuit and interconnection cables schematics.

1.2. REFERENCE DOCUMENTS

- [RE1] VLT-SPE-ESO-10000-0015 VLT Electronic Design Specification Issue 4.0 09/12/96.
- [RE2] “Baumer Electric” Catalogue.
- [RE3] “Miniature Drive Systems” Faulhaber 2001-2002

1.3. APPLICABLE DOCUMENTS

- [AP1] “High Efficiency Mode Upgrade: Users Requirements and Implementation Plan” 3M6-SPE-ESO-13100-0012 Issue 1.3 March 5, 2004. G. Lo Curto, L. Pasquini, G. Rupprecht.
- [AP2] “HARPS High Efficiency Mode Software Design Description” 3P6-SDS-ESO-80030-0005 Issue 1.3 March 14, 2005 Tzu-Chiang Shen.

1.4. ACRONYMS & ABBREVIATIONS

HARPS	High Accuracy Radial-velocity Planetary Search
RV	Radial Velocity
HEF	High Efficiency Fiber
HEFS	High Efficiency Fiber Shutter
HAM	High Accuracy Mode
HEM	High Efficiency Mode
DC	Direct Current
LED	Light Emitting Diode
LCU	Local Control Unit
TBD	To Be Defined
TBM	To Be Measured
VME	Versa Module Europe
BJP	Boîte de Jonction PULPO
SESO	Electronic Company from “Observatoire de Haute Provence” producing shutter driver electronics.

2. SHUTTER MECHANISM

2.1. Overview

The HEFS mechanism uses a small Direct Current (DC) electric motor driving a bi-stable mechanism loaded with a spring. The rotation of the motor axis is confined to a few degrees by suitable mechanical stops and directly drives the small shutter blade. By momentarily energizing the motor with the required polarity the mechanism changes state, immediately after the state change the current is switched off, by the control electronics, avoiding any further power dissipation. Please refer to Figure 1 below for details.

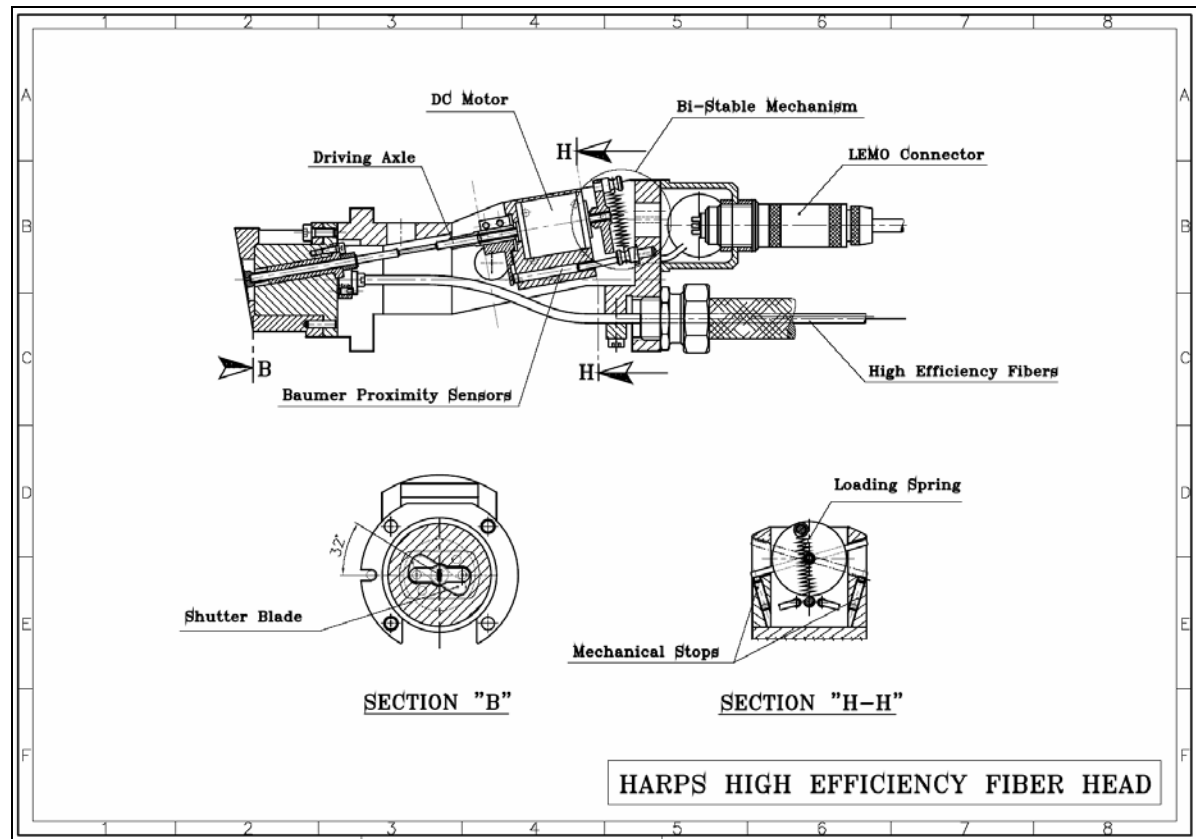


Figure 1 : HEFS and Fiber Head Mechanical Drawing

2.2. Motor

A custom built, axle protruding from both sides, Faulhaber DC micro-motor with the following electromechanical characteristics is used.

Manufacturer		FAULHABER
Type		2025-024S
Voltage	V	24
Resistance	Ω	102
Output power	W	1.41
Efficiency	%	73
Stall torque	mNm	4.53
Current constant	mNm/A	0.051

Table 1 : DC Motor Characteristics

2.3. Open-Close Sensors

Both shutter states, open and close, are sensed by Baumer Electric inductive proximity sensors model IFR 05.26.25 NPN type.

2.4. Cabling

The shutter mechanical assembly (Figure 1) incorporates a Lemo #2 8 pin chassis type connector for the complete electrical connection, motor and state sensors, to the driving electronics. For a detailed connection diagram please refer to 4.7 “HEFS Shutter Wiring”.

3. CONTROL ELECTRONICS

3.1. Overview

The HEFS control electronics comprises two boxes named “Control Box” and “Driver Box”. Both boxes are powered independently by direct connection to the 220V mains.

The control box is a standard rack mounted 19” width 1U (41mm) height unit, to be installed in the HARPS Detector Unit / Vacuum Vessel rack. The control box front panel comprises four toggle switches and two Light Emitting Diodes (LEDs). Please refer to Figure 2 below for functionality details. At the rear panel the control box comprises four connectors and the 220V AC inlet.

The driver box is a small metallic housing of 80 X 50 X 150mm approximate dimensions, to be installed somewhere over the outside walls of the HARPS adapter. Externally the control box comprises two connectors and the 220V AC inlet.

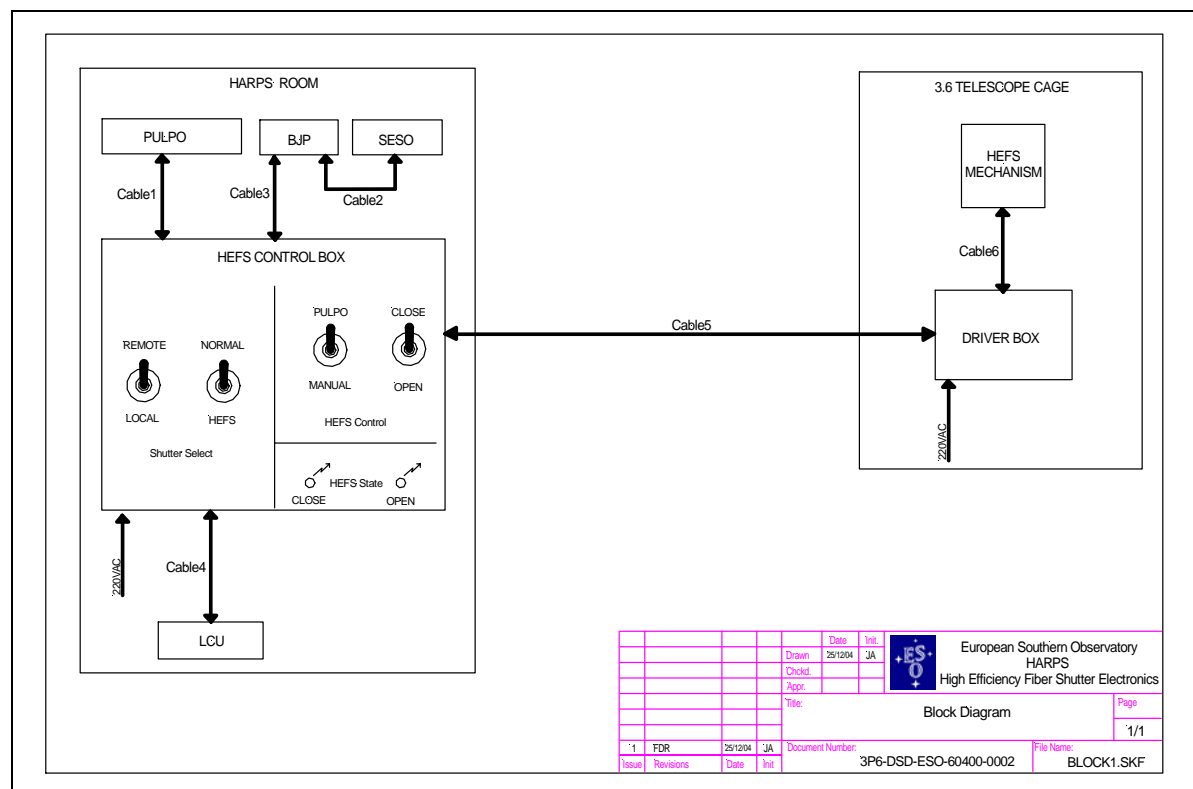


Figure 2 : HEFS Electronics Block Diagram

3.2. HEFS Control Box

The control box main functions are:

- Switching the PULPO's single shutter control channel between the normal shutter and the HEFS. The switching could be done locally by toggling a front panel switch or remotely via Local Control Unit (LCU) command. The local or remote mode selection status is reported back to the LCU. Both signals are opto-isolated.
- Send the HEFS open/close command to the driver box and receive the open/close status signals from the driver box.
- HEFS operation mode selection between local manual command or PULPO command. The Manual/PULPO status is reported back to PULPO.

Please refer to 4.3 "HEFS Control Box Power Supply" and 4.4 "HEFS Control Box Circuit" for the electronic design details.

3.3. HEFS Driver Box

The driver box main functions are:

- Reception of the open/close command and accordingly drive the shutter's electric motor for a predefined time of approximately 500mS. The signal is opto-isolated.
- Send back to the control box the open and close status signals.

Please refer to 4.5 "HEFS Driver Power Supply", 4.6 "HEFS Driver Box Circuit" and 4.7 "HEFS Shutter Wiring" for the electronic design details.

3.4. HEFS Connection to the System

The HEFS connection to the actual system is accomplished by:

- Unplugging "Cable1", corresponding to the PULPO shutter channel signals, at the BJP end and plugging it to the new HEFS control box.
- Plugging the new "Cable3" between the BJP and the HEFS control box.

Cable1 and Cable2 are actual cables, just by the aid of the new "Cable3" the HEFS electronics is inserted into the system. Please refer to Figure 3 below.

With the "Normal" shutter selected the "HEFS Control Box" plus "Cable3" act as a one to one pin to pin extension to the original "Cable1".

Note that no hardware modification to the actual system is necessary for integrating the new shutter. Re-establishing the actual configuration is just a matter of unplugging three connectors and plugging back one connector.

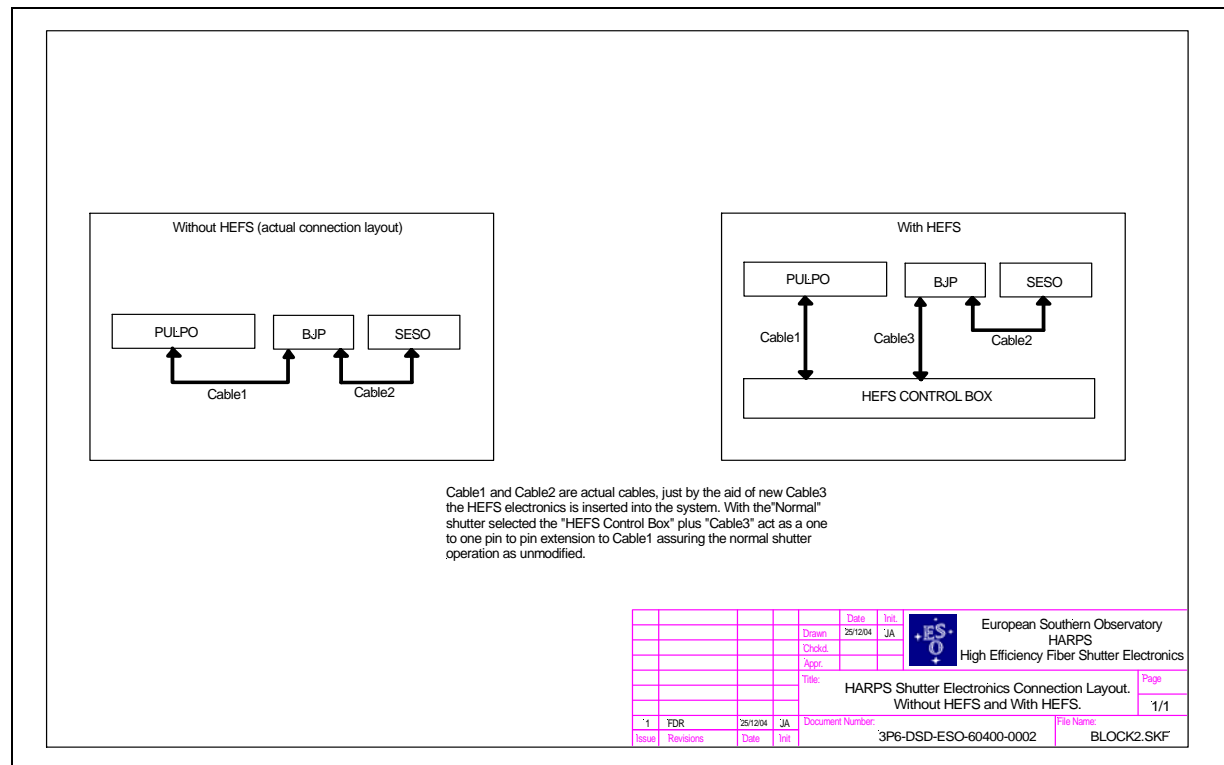


Figure 3 : HEFS Connection to the System

3.5. Cabling

HEFS cabling comprises only four cables named “Cable3”, “Cable4”, “Cable5” and “Cable6”. The particular cable function and characteristics is as follows:

- “Cable3” : HEFS Control Box to BJP box, carry the PULPO shutter command signals to SESO. Please refer to 4.8 “HEFS Interconnection Cables” for detailed schematics and connector types.
- “Cable4” : Control Box to ACRO, carry the Normal/HEFS toggling and status signals. Please refer to 4.8 “HEFS Interconnection Cables” for detailed schematics and connector types.
- “Cable5” : Control Box to Driver Box, carry the open/close drive and status signals. Please refer to 4.8 “HEFS Interconnection Cables” for detailed schematics and connector types.
- “Cable6” : Shutter Mechanism to Driver Box. Please refer to 4.8 “HEFS Interconnection Cables” for detailed schematics and connector types.

3.6. VME Interface

The HAM or HEM mode shutters could be selected manually, at the HEFS control box” via the switch “Shutter select” when the switch “Mode” is set to “local”. When the switch “Mode” is set to “LCU” the shutters are selected via the HARPS LCU ACRO.

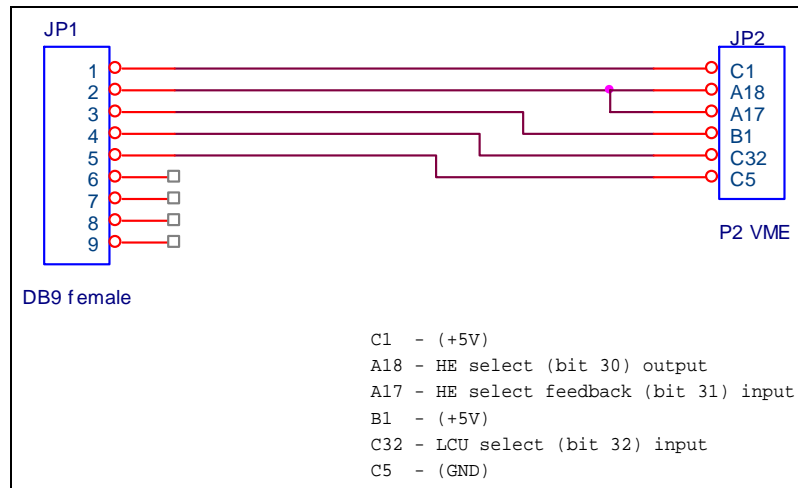


Figure 4 : HARPS LCU wiring

VLT BIT	DIRECTION	NAME	LOGIC
30	OUTPUT	<i>HE Select</i>	Active low
31	INPUT	<i>HE Select feedback</i>	Active low
32	INPUT	<i>LCU Select</i>	Active low

Table 2 : HARPS LCU ACRO bits

<i>HE Select</i>	Output signal for selecting HEM or HAM from the LCU.
<i>HE Select feedback</i>	Input signal feedback from the HEM or HAM selection.
<i>LCU Select</i>	Input signal indicating to the LCU that the HEM or HAM selection is done by the LCU.

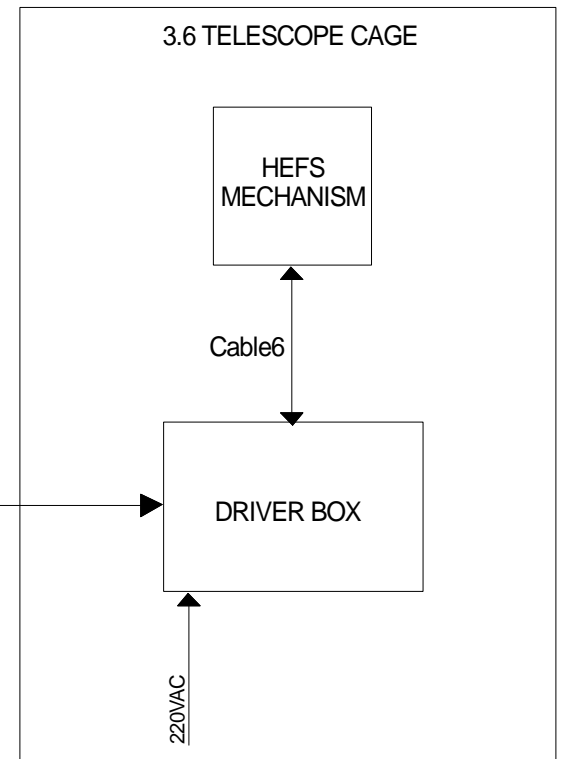
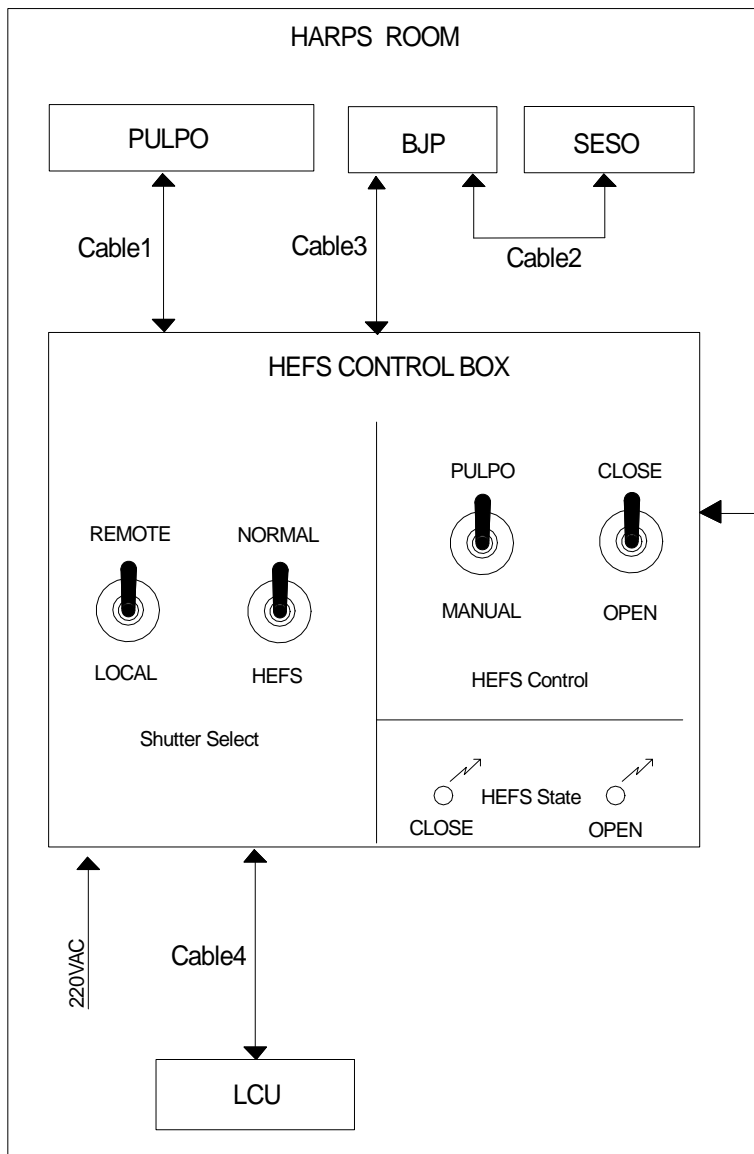
Table 3 : Signal Name Description

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4. SCHEMATIC APPENDIX

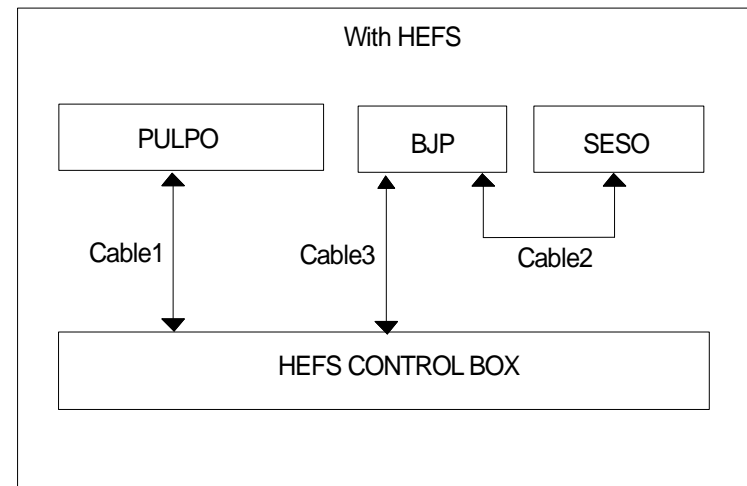
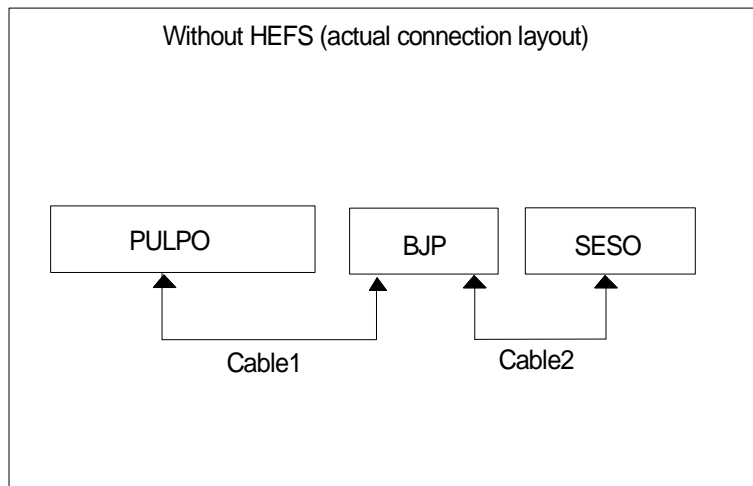
The block and circuit schematic diagrams are listed below and annexed to this document as nine A4 format sheets.

- 4.1. *Block Diagram***
- 4.2. *Harps Shutter Electronics Connection Layout***
- 4.3. *HEFS Control Box Power Supply***
- 4.4. *HEFS Control Box Circuit***
- 4.5. *HEFS Driver Power Supply***
- 4.6. *HEFS Driver Box Circuit***
- 4.7. *HEFS Shutter Wiring***
- 4.8. *HEFS Interconnection Cables***
- 4.9. *HARPS High Efficiency Fiber Head***




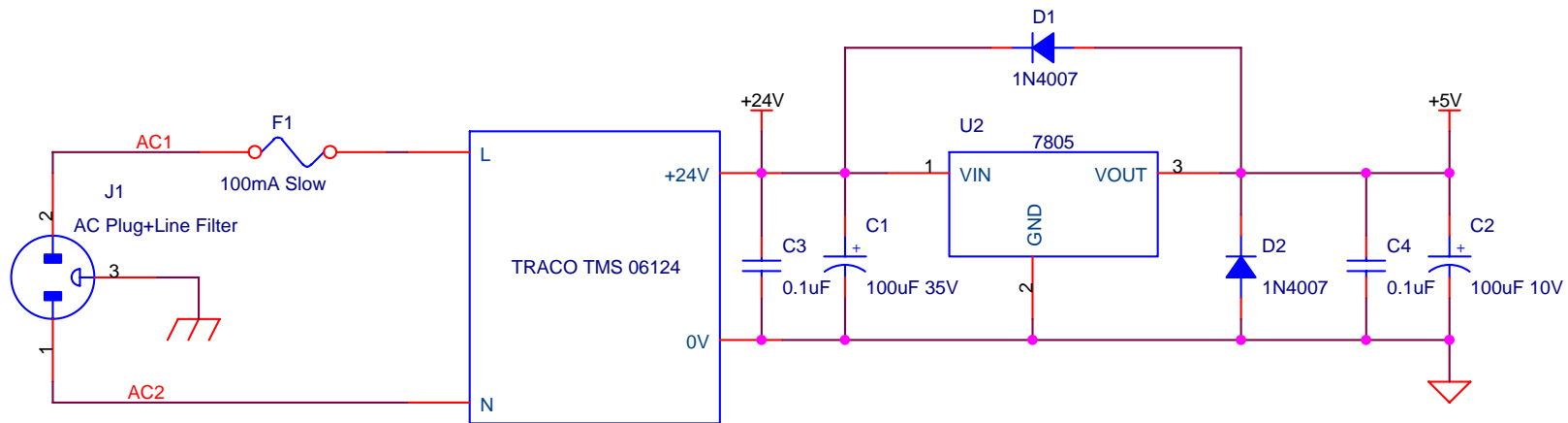
Cable5

				Date	Init.	 European Southern Observatory HARPS High Efficiency Fiber Shutter Electronics		
			Drawn	25/12/04	JA			
			Chkd.					
			Appr.					
			Title:				Block Diagram	Page
								1/1
1	FDR	25/12/04	JA	Document Number:		3P6-DSD-ESO-60400-0002	File Name:	
Issue	Revisions	Date	Init				BLOCK1.SKF	



Cable1 and Cable2 are actual cables, just by the aid of new Cable3 the HEFS electronics is inserted into the system. With the "Normal" shutter selected the "HEFS Control Box" plus "Cable3" act as a one to one pin to pin extension to Cable1 assuring the normal shutter operation as without HEFS.

				Date	Init.	 European Southern Observatory HARPS High Efficiency Fiber Shutter Electronics
			Drawn	25/12/04	JA	
			Chckd.			
			Appr.			
Title:						Page
HARPS Shutter Electronics Connection Layout. Without HEFS and With HEFS.						1/1
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Issue	Revisions	Date	Init	3P6-DSD-ESO-60400-0002		BLOCK2.SKF

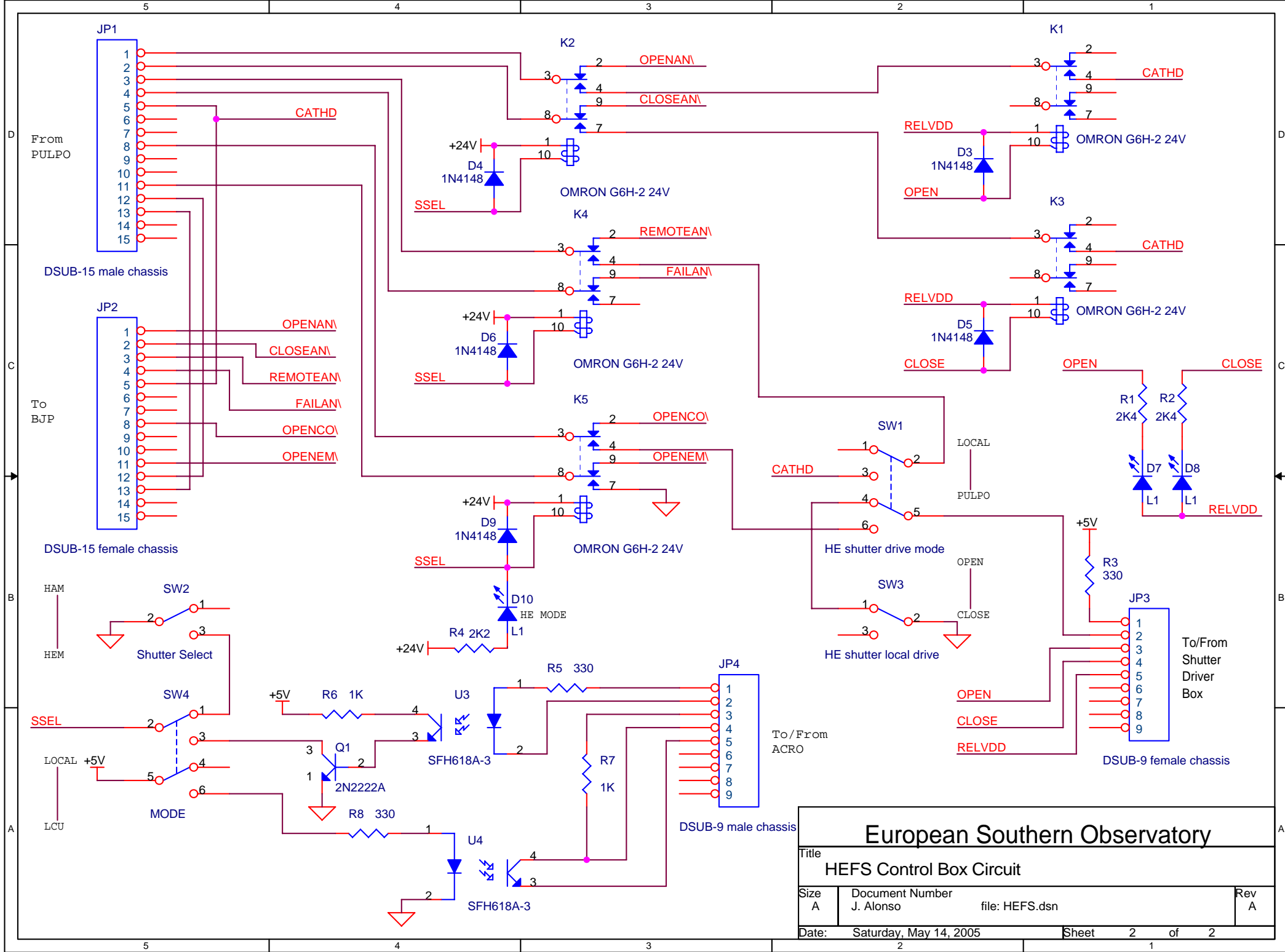


European Southern Observatory

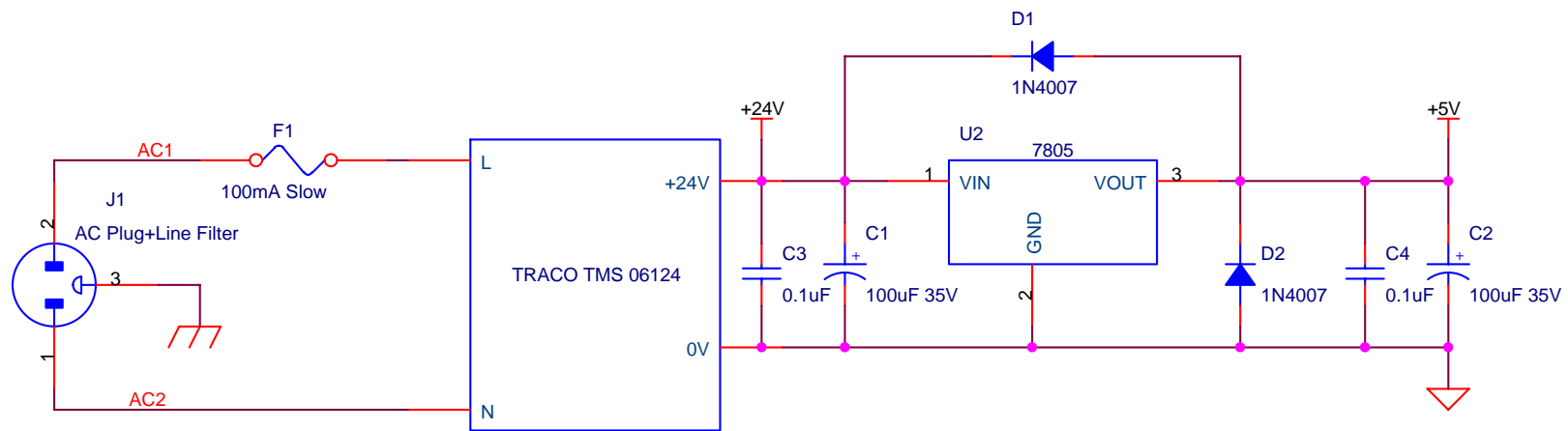
Title
HEFS Control Box Power Supply

Size A	Document Number J. Alonso file: HEFS.dsn	Rev A
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Date: Saturday, May 14, 2005 Sheet 1 of 2

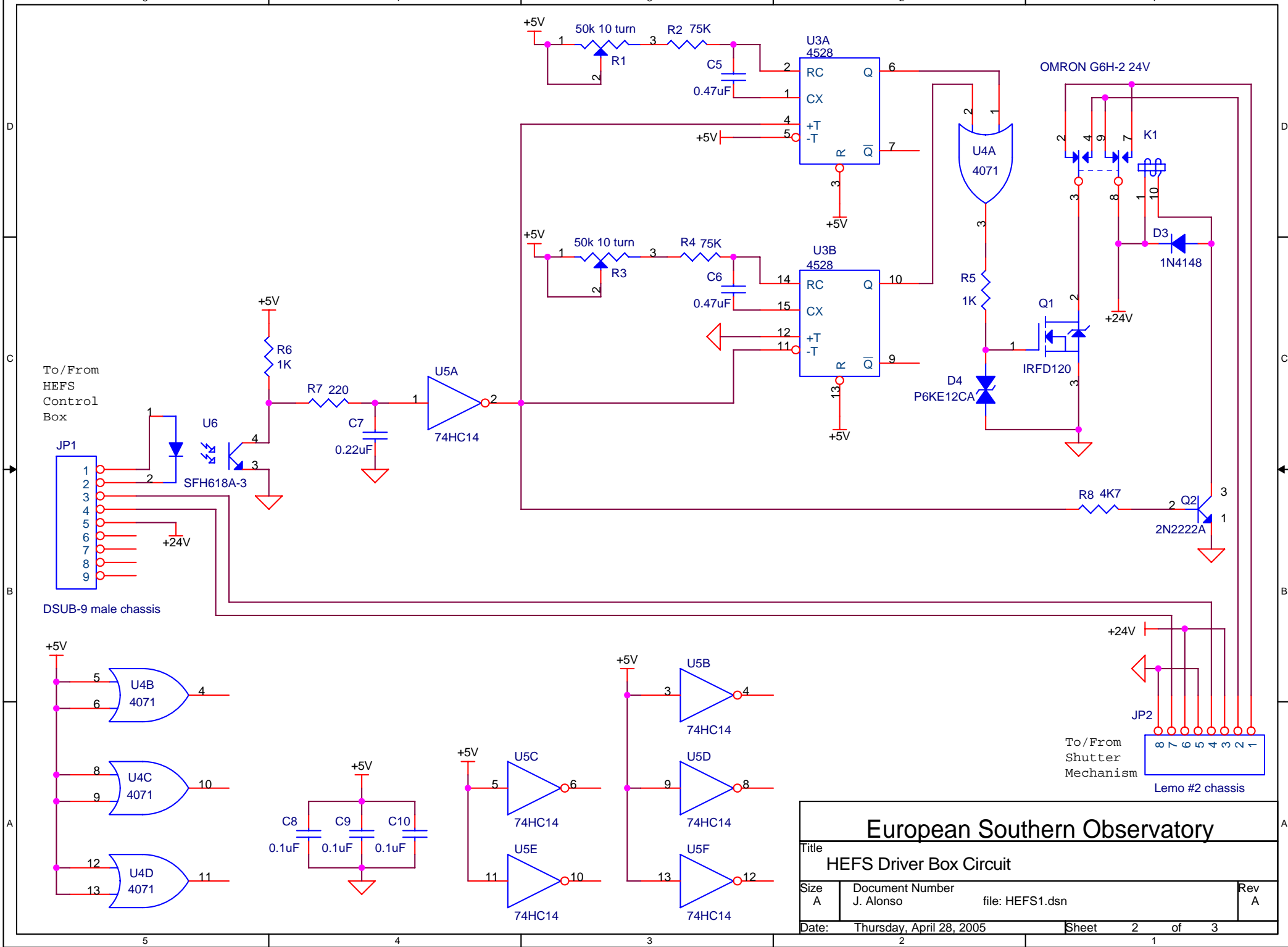


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Date: Saturday, May 14, 2005	Sheet 2	of 2

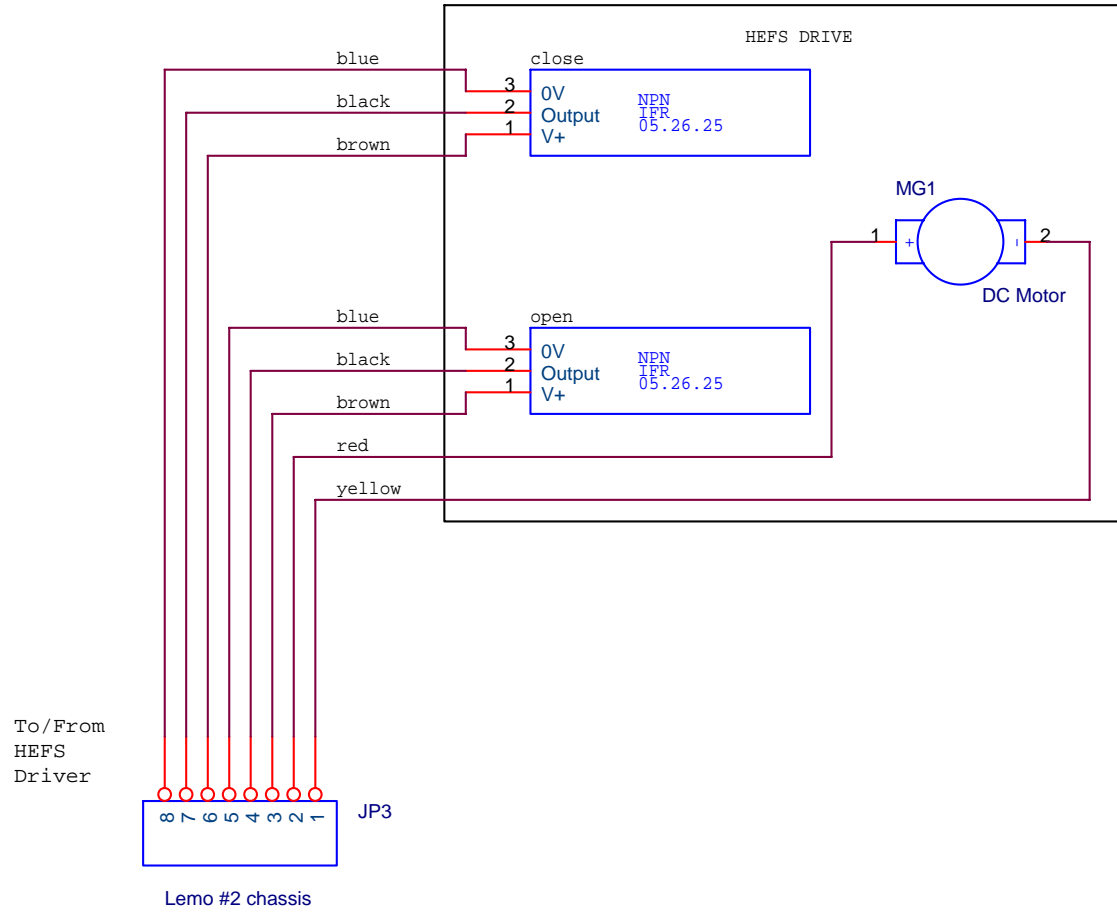


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HEFS Driver Power Supply		
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Date:	Thursday, April 28, 2005	Sheet 1 of 3

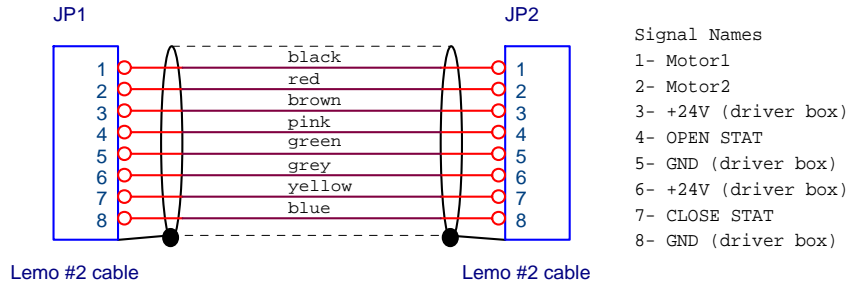


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Date: Thursday, April 28, 2005	Sheet 2	of 3



European Southern Observatory		
Title HEFS Shutter Mechanism Wiring		
Size A	Document Number J. Alonso file: HEFS1.dsn	Rev A
Date: Thursday, April 28, 2005	Sheet 3 of 3	

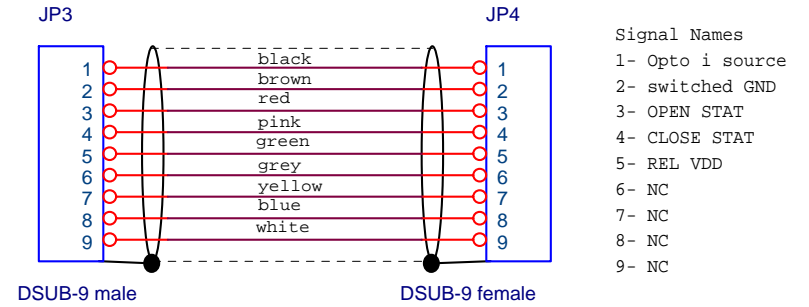
Shutter Mechanism to Driver Box



NOTES

- Custom made flexible cable
- Shield connected to connector's housing at both ends.
- Length 3.5m
- Name: "Cable6"

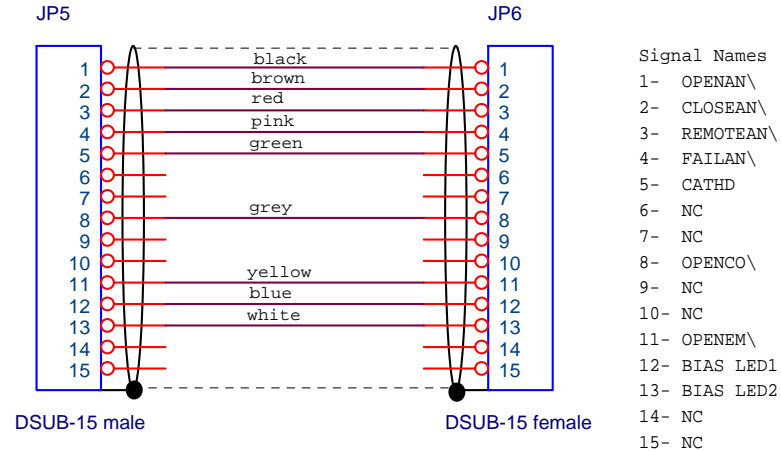
Control Box to Driver Box



NOTES

- 0.25 sqmm cable (KROSCHU - SCHALTFLEX 12X0.25).
- Use metallic covers with screw type fixations.
- Shield connected to connector's housing at both ends.
- Length 38m
- Name: "Cable5"

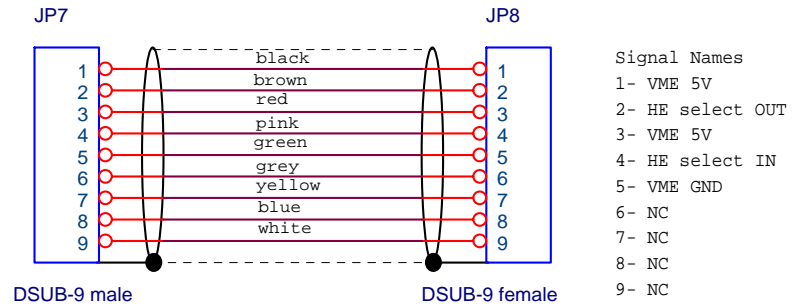
HEFS Control Box to BJP (Insertion Cable)



NOTES

- 0.25 sqmm cable (KROSCHU - SCHALTFLEX 12X0.25).
- Use metallic covers with screw type fixations.
- Shield connected to connector's housing at both ends.
- Length 4m
- Name: "Cable3"

Control Box to ACRO

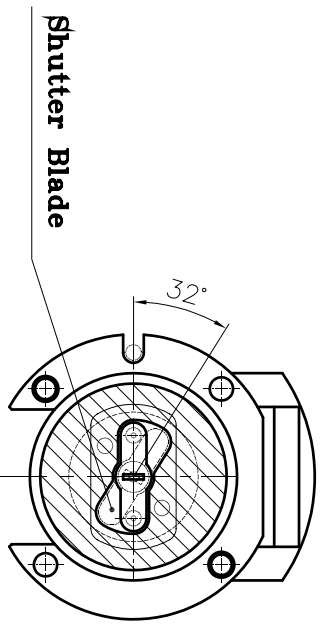
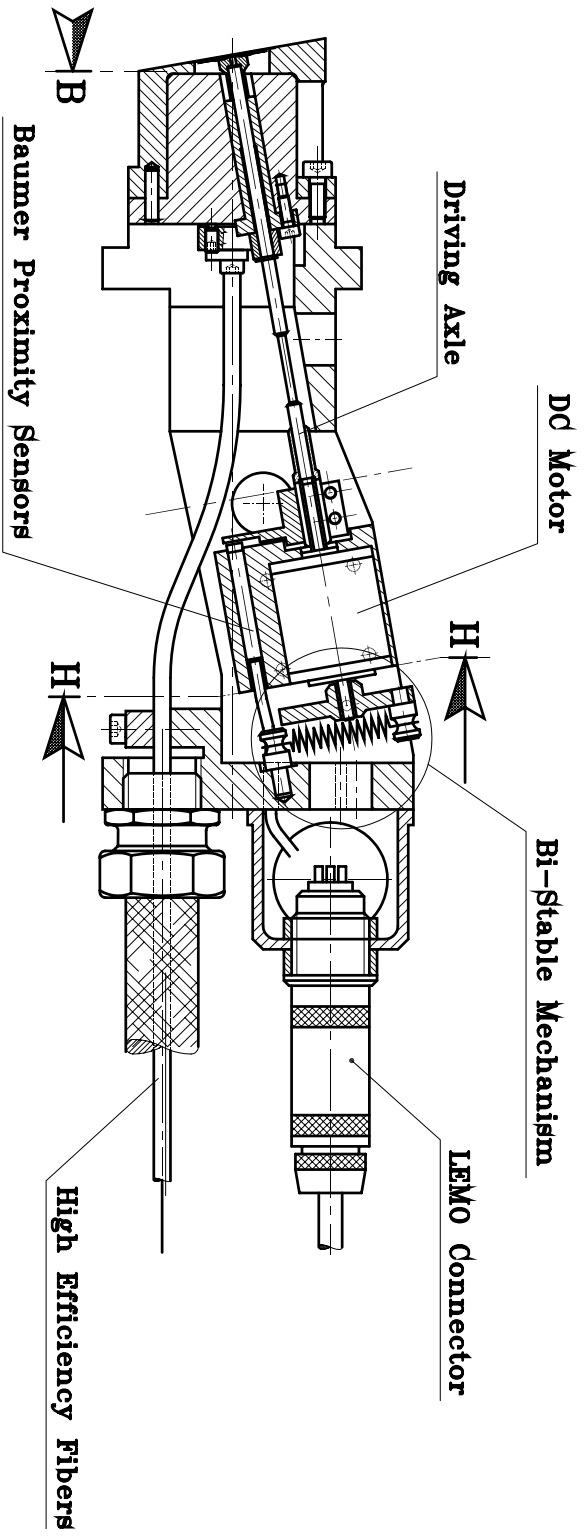


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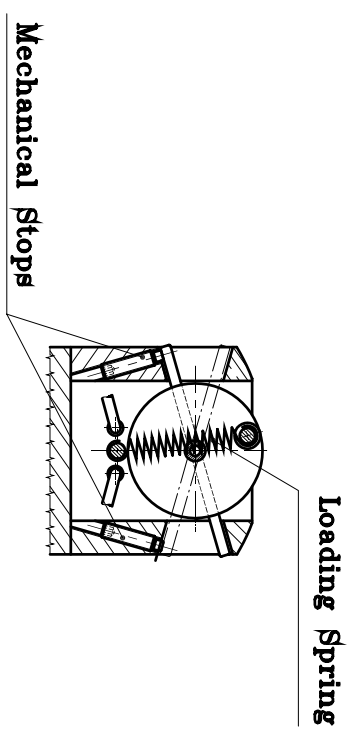
- 0.25 sqmm cable (KROSCHU - SCHALTFLEX 12X0.25).
- Use metallic covers with screw type fixations.
- Shield connected to connector's housing at both ends.
- Length 19m
- Name: "Cable4"

European Southern Observatory

Title		
HEFS Interconnection Cables		
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SECTION "B"



SECTION "H-H"

HARPS HIGH EFFICIENCY FIBER HEAD

