EUROPEAN SOUTHERN OBSERVATORY

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LA SILLA-PARANAL OBSERVATORY

3P6 LATERAL PADS CONTROL ELECTRONICS

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1. INTRODUCTION

The 3p6 main mirror support comprises an open loop pneumatic lateral pad supporting system that, as a function of the telescope tube inclination, adjusts the air pressure inside several rubber chambers evenly distributed at the periphery of the main mirror. These chambers maintains the mirror radially constraint inside the cell by an inclination dependent supporting force distribution around it.

Obsolescence and the unavailability of spare parts for this old PC based system together with the need of extracting the last drop of optical quality possible with such a telescope motivated the design of a VLT complaint lateral pad control system.

The goal is to implement a VME system with superior computing power together with VLT standard hardware modules and software [RE3][AP1]. Such a system will, during presets, keep the force distribution adjusted depending on the telescope tube inclination, exactly as done with the actual system. During tracking the new system will use the actual force readout from the load cell sensors, actually used for monitoring purposes only, for closing a control loop and maintaining exactly the required force distribution at every instant. Please refer to [RE3][AP2].

1.1. PURPOSE AND SCOPE

This document is intended to serve as an electronic design and construction document for the new 3P6 lateral pads control system.
Starting from a general description and block diagram it goes all the way trough the necessary custom boards for signal conditioning, chassis and cabling details including circuit schematics and wiring.

1.2. REFERENCE DOCUMENTS

[RE1] VLT-SPE-ESO-10000-0015 VLT Electronic Design Specification Issue 4.0 09/12/96.
[RE2] Mikro Elektronik gmbh-Nürnberg www.men.de
[RE3] VLT-MAN-ESO-17210-3559 VxWorks driver for MEN M-Modules User Manual. Issue 1.0 15/05/2005 T. Ebert.

1.3. APPLICABLE DOCUMENTS

[AP1] "Control Electronics Upgrade for the 3p6 Mirror Support" J. Alonso 20-OCT-2005
[AP2] "ESO 360 M1 Lateral Pad Upgrade User Requirements" Doc. No. 3P6-URS-ESO-90400-0002 Issue 1.2 29/03/2005 E. Barrios.
[AP3] "3P6 Lateral Pads Control Electronics Conceptual Design" Doc. No. 3P6-DSD-ESO-60400-0004 Issue 1.0 05/01/2006 J. Alonso.
[AP4] VLT-SPE-ESO-10000-0015 VLT Electronic Design Specification Issue 4.0 09/12/96.

1.4. ACRONYMS & ABBREVIATIONS

A	Analogue
AC	Alternating Current
ADU	Analogue Digital Unit
A/D	Analogue to Digital
CPU	Central Processing Unit
D/A	Digital to Analogue
D	Digital
DC	Direct Current
D I/O	Digital Input Output
GND	Ground
PC	Personal Computer
RITZ	Remote Instrument and Telescope Zentrum
LCU	Local Control Unit
I/O	Input Output
VME	Versa Module Europe
MEN	Mikro Elektronik gmbh-Nürnberg
DC	Direct Current
LED	Light Emitting Diode
PCB	Printed Circuit Board
TBD	To Be Defined
TBM	To Be Measured
ISA	Industry Standard Architecture
VLT	Very Large Telescope
VME	Versa Module Europe
NU	Not Used
PI	Proportional Integral

2. GENERAL OVERVIEW

The system design is based on modern ESO standard VME modules for analogue and digital signal I/O. For details on the required precision, resolution and throughput for the A/D and D/A conversion system, please refer to [RE3][AP1].

From the control point of view the algorithm chosen is a classical PI type controller, for details on the implementation please refer to the software documentation. In supporting the optimal tuning of the control system the phase/frequency response will be measured experimentally at different telescope tube inclinations by the aid of a low frequency spectrum analyzer (HP 3582A) with transfer function measuring capabilities using noise stimulus.

The electronic design approach maximises the use of standard parts and minimizes the number of different custom boards for “gluing” and signal conditioning. Thus the approach simplifies the wiring, construction and spare parts count. Two main sub-systems will comprise the electronics:

1 - ESO Standard VME LCU chassis (only VME DC supplies required, no auxiliary supplies) fitted with a Power PC CPU and three A201S carrier boards from MEN electronics plus one Motorola transition module. The carrier boards are fitted with A/D, D/A and D I/O mezzanine boards from MEN manufacturer.

2 - Signal conditioning chassis. This chassis has the same height of the standard VME chassis, it will only support mechanically seven double width boards with built in DC power supplies for total galvanic isolation and stabilization. Only three types of custom boards will be employed in this chassis:

I - Board type 1 amplifies the low level signals from the load cells. It provides 15 channels with offset calibration facilities and excitation supply for each load cell. Additionally it provides galvanic isolation and clean routing of the analogue signals to the VME A/D converters. A total of four units are employed (MOD01, MOD02, MOD03 and MOD04 in the block diagram Figure 1 below).

II - Board type 2 accepts the signals from ten proportional valves with built in pressure sensors and one inclinometer sensor. It allows clean routing and galvanic isolation of the analogue signals from and to the VME D/A and A/D converters. Additionally it provides the necessary power supply voltage for the valves and inclinometer. A total of two units are employed (MOD05 and MOD06 in the block diagram Figure 1 below).

III - Board type 3 interfaces an analogue pressure sensor fitted to the main air supply of the pneumatic system. By hardware it actuates the mirror clamping system in case of out of range air pressure providing visual indication via LEDs and reporting to the LCU via digital and analogue I/O. Additionally it contains a watch dog timer that monitors

the normal operation of the VME LCU. If the LCU does not refresh the watch dog timer within approximately “2 boot time” the watch dog clamps the system. A total of one unit is employed (MOD07 in the block diagram Figure 1 below).

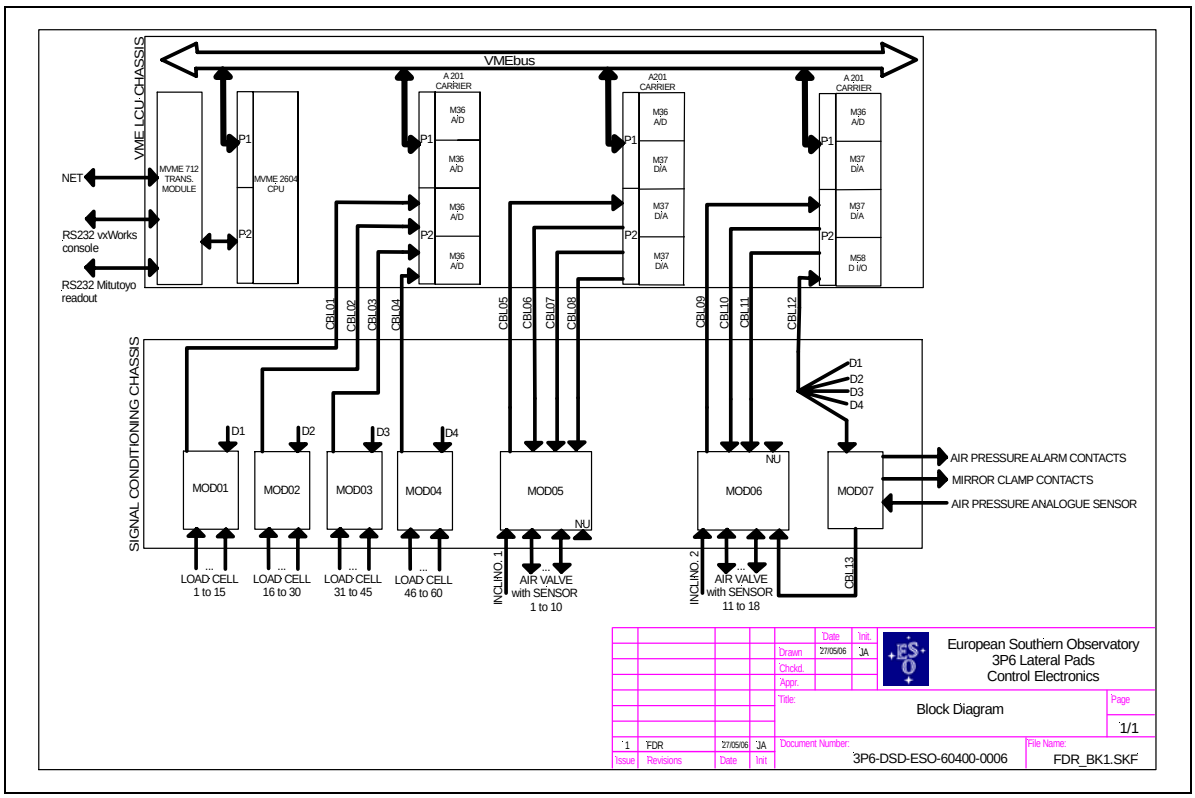


Figure 1 : Electronic System Block Diagram

The cabling between the VME LCU chassis and the signal conditioning chassis is done by CLB01 trough CLB12 (see block diagram Figure 1 above). These cables are commercial cables from MEN that come already fitted with special connectors on one end. The other end is delivered without connector. Together with the cables MEN provides an adapter that on one side fits on the standard P2 connector of the A201S carrier board (a sort of single mini P2 backplane) and on the other has 4 receptacles that mate the special connector in the cables (for details please refer to Figure 2 and Figure 3 section 5). Each receptacle allows independent connection to each mezzanine board mounted over the carrier. At the signal conditioning chassis each cable is terminated with in house fitted 9 or 25 pin DSUB connectors, as required, for mating PCB mounted DSUB connectors over the different custom boards, resulting in only three types of finished cables.

I - Cables CBL01 trough CBL04, CBL05 and CBL06 are type 1.
II - Cables CBL06 trough CBL08, CBL10 and CBL11 are type 2.
III - Cable CBL12 is type 3.

3. MAIN ELECTRONIC SUB-SYSTEMS

3.1. VME LCU Chassis

The LCU requires only the standard VME voltages and is fitted with the following modules:

- 1 unit MVME 712/M transition module (Motorola standard).
- 1 unit MVME 2604 Power PC CPU (Motorola standard).
- 1 unit A201 S-6U Carrier board fitted with 4 M36 A/D mezzanines (MEN).
- 1 unit A201 S-6U Carrier board fitted with 1 M36 A/D mezzanine and 3 M37 D/A mezzanines (MEN).
- 1 unit A201 S-6U Carrier board fitted with 1 M36 A/D mezzanine 2 M37 D/A mezzanines and 1 M58 32 bit TTL I/O mezzanine (MEN).

The chassis construction is based on the ESO standard type comprising:

- VME bus 10 slots – Active Termination - Auto Daisy Chain P1 backplane.
- VME power supply KNIEL FPM 300W.
- AC Line Filter – Fuse – Switch.

For construction details please refer to 9.15, 9.16 and 9.17.

3.2. Signal Conditioning Chassis

The signal conditioning chassis is simply implemented by ESO standard LCU basic mechanical components. It comprises two lateral parts together with cross profiles fitted with plastic slides for accepting 7 double width signal conditioning modules. No backplanes are used. At the rear side it is left open and only a plate is mounted for supporting the 220V inlet plug, switch, line filter and fuse.

For construction details please refer to 9.18 and 9.19.

4. SIGNAL CONDITIONING BOARDS

Basically only three type of conditioning boards or modules are used in the system. All three types are directly powered from the 220V mains and incorporate multiple regulation and filtering stages for generating on module the required DC voltages. In this way the ground network of each module is effectively isolated from the others. In turn this preserves the isolation built in each MEN mezzanine board allowing not to compromise the conversion precision and dynamic range of the D/A and A/D circuits due to ground loops. Additionally the approach simplifies the wiring and spare parts count.

4.1. Board Type 1

Board type 1 amplifies the low level signals from the load cells. It provides 15 channels with offset calibration facilities and excitation supply for each load cell. Additionally it provides galvanic isolation and clean routing of the analogue signals to the VME A/D converters.

The main circuit block, repeated fifteen times, in this board is a combination of a special new technology “zero” drift instrumentation-amplifier utilizing internal shopping circuitry for compensation combined with an external phase reversal differential analogue switch at the input for allowing the software to measure exactly the offset voltage present in the output of each amplifier. To determine the offset of the amplifiers the software just makes two analogue conversions, one straight and one inverted then the difference between the two conversions represents the offset for that particular channel. Since the input offset voltage drift coefficient of this amplifiers is very small (typically 50nV/ºC) the operation can be done only once per day and/or when the temperature changes significantly (say more than 20 ºC). The phase reversal command comes from one bit of the MEN D I/O. The signal bit is opto-isolated to avoid upsetting the ground net.

For sake of convenience considering that the A/D converters chosen for the application has 16 bit resolution and the nominal full scale range of all the load cells with the applied 5V excitation voltage is 0 to 10mV the gain of the amplifiers was set all the same at a nominal 682 V/V. Considering the +/-10V A/D maximum input range and the maximum applied analogue range of +/-6.82V this gives more than 14 bit resolution with a dynamic reserve > +/-10.000 ADU, allowing ample margin for offsets and full scale range differences in the channels without reaching converter saturation. On the analogue side the amplifier and phase reversal analogue switch rails are powered by +/-7.7V allowing a maximum analogue range of +/-7.4V giving an analogue front-end dynamic reserve of ~ +/-2000 ADU.
The gain setting is done utilizing 0.1% precision 25ppm/ ºC resistors. Anyhow each board will be delivered with the actual gain measured for each channel.

Since the MEN A/D has 16 channels and we are using only 15 the 16th channel is deliberately connected to the ground net of the board. This allows for software

compensation of the offsets generated by the voltage follower, sample & hold and converter inside the MEN A/D. Just do a conversion of channel 16th and keep the value for compensation.

The double width front panel will comprise:

- Fifteen 4 pin PCB mounted LEMO connectors type EPG.0B.304.HLN for connecting fifteen load cells. Although expensive these connectors provide reliable contacts with efficient screening of the low level input signals.
- One power led with disable switch.

The rear side of the board will comprise:

- One 25 pin PCB mounted female DSUB connector outputting the amplified load cell signals to the MEN A/D.
- One 9 pin PCB mounted male DSUB connector receiving the polarity reversal bit from the MEN D I/O.
- One 3 pin Phoenix Contact COMBI (5.08 mm grid) type screw terminal/connector for the 220V mains power.

For circuit details please refer to 9.2, 9.3, 9.4, 9.5, 9.6 and 9.7.

4.2. Board Type 2

Board type 2 accepts the signals from ten proportional valves with built in pressure sensors and one inclinometer sensor. It allows clean routing and galvanic isolation of the analogue signals from and to the VME D/A and A/D converters. Additionally it provides the necessary power supply voltages for the transducers.
From the signal point of view this is a passive board that strategically routes the multiple signals from both the air valves/pressure sensors units and inclinometer.

The double width front panel will comprise:

- Eleven 4 pin Phoenix Contact COMBI (3.81mm grid) type screw terminal/connector directly mounted over the PCB for receiving the valves and inclinometer connection cables.
- One power led with disable switch.

The rear side of the board will comprise:

- One 25 pin PCB mounted female DSUB connector outputting the air valve's pressure sensors signals to the MEN A/D.
- Three 9 pin PCB mounted female DSUB connectors receiving the drive signals to the air valves from three MEN D/A.
- One LEMO coaxial connector used as auxiliary analogue input.

- One 3 pin Phoenix Contact COMBI (5.08 mm grid) type screw terminal/connector for the 220V mains power.

For circuit details please refer to 9.8, 9.9 and 9.10.

4.3. Board Type 3

Board type 3 interfaces an analogue FESTO piezo-resistive pressure sensor type SDE-10-10V that provides a voltage output of 0 to 10V directly proportional to the pressure input corresponding to 0 to 10bar with 0.5% full scale precision. The sensor is fitted to the main air supply of the pneumatic system. By hardware the board actuates the mirror clamping system in case of out of range air pressure providing visual indication via LEDs and reporting to the LCU via digital and analogue I/O. The detection circuit for the pressure points (2.0, 2.8 and 3.2 bar) is implemented by window comparators with built in ~120mV hysteresis for avoiding oscillations. Additionally the board contains a watch dog timer that monitors the normal operation of the VME LCU. If the LCU does not refresh the watch dog timer within approximately “2 boot time” the watch dog clamps the system an issues a visual warning.

The double width front panel will comprise:

- Three 4 pin Phoenix Contact COMBI (3.81mm grid) type screw terminal/connector directly mounted over the PCB for connection of the FESTO pressure sensor, air pressure alarm and mirror clamp air valve.
- Air pressure < 2.0 bar red LED.
- Air pressure < 2.8 bar red LED.
- Air pressure > 3.2 bar red LED.
- LCU dead red LED.
- Main mirror locally clamped green LED.
- Power green LED.
- LEDs off switch.
- Mirror clamp switch (local).

The rear side of the board will comprise:

- One 9 pin PCB mounted male DSUB connector carrying digital I/O signals to and from the MEN D I/O. The output signals is: refresh watch dog. The input signals are: pressure levels and locally clamped reporting plus watch dog refresh feedback.
- One 3 pin Phoenix Contact COMBI (5.08 mm grid) type screw terminal/connector for the 220V mains power.

For circuit details please refer to 9.11, 9.12, 9.13 and 9.14.

5. WIRING

5.1. VME LCU Chassis – Signal Conditioning Chassis

The whole interconnection between the VME LCU chassis and the signal conditioning chassis is done using the two accessories shown in the pictures below. As previously explained in section 2 only three types of cables are required.

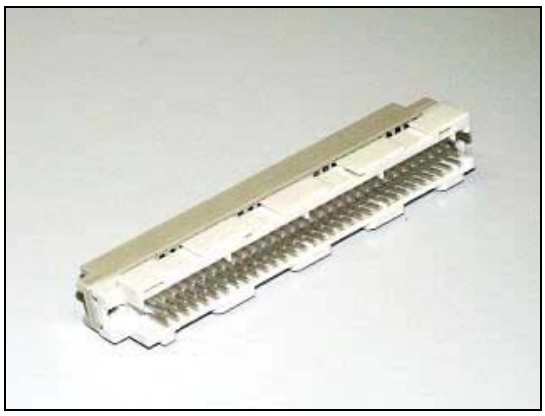


Figure 2 : **05M000-02** VMEbus P2 connector.

Figure 2 above shows the commercial adapter for cable connection of 4 21-pin M-Module™ cables (05M000-01) for mounting in VMEbus enclosure without P2 backplane, consisting of 96-pin shroud and receptacle.

Figure 3 : **05M000-01** M-Module™ cable.

Figure 3 above shows the two meters commercial cable, 21-pin VG receptacle to pig tail, for connection to VMEbus P2 mating connector (05M000-02), for wiring of M-Module™ I/O signals via P2.

5.1.1. Cable Type 1

Signal Name	21 pin Receptacle Connector Pin #	25 pin male DSUB Pin #	Line Colour
I0	1	1	
I1	5	2	
I2	9	3	
I3	7	4	
I4	11	5	
I5	15	6	
I6	13	7	
I7	17	8	
I8	2	9	
I9	6	10	
I10	4	11	
I11	8	12	
I12	12	13	
I13	10	14	
I14	14	15	
I15	18	16	
IGND	19	17, 18, 19, 20 21, 22, 23, 24 25	

Table 1 : Cable Type 1 Interconnections

- Quantity: 6
- Length: TBM
- Cable: M-Module cable 05M000-01
- Connector: 25 pin male DSUB with metalized plastic cover and screw type fixations.

NOTE: The colour assignment of the lines is not available at the MEN online documentation. According to MEN the data comes with the physical product.

5.1.2. Cable Type 2

Signal Name	21 pin Receptacle Connector Pin #	9 pin male DSUB Pin #	Line Colour
V0	1	1	
V1	5	2	
V2	9	3	
V3	13	4	
IGND	4	5	
IGND	7	6	
IGND	8	7	
IGND	11	8	
IGND	12	9	

Table 2 : Cable Type 2 Interconnections

- Quantity: 5
- Length: TBM
- Cable: M-Module cable 05M000-01
- Connector: 9 pin male DSUB with metalized plastic cover and screw type fixations.

5.1.3. Cable Type 3

Signal Name	21p Receptacle Connector Pin #	9 p female DSUB D1 Pin #	9 p female DSUB D2 Pin #	9 p female DSUB D3 Pin #	9 p female DSUB D4 Pin #	9 p female DSUB D5 Pin #	Line Colour
PIO_A0	3	-	-	-	-	1	
PIO_B0	7	-	-	-	-	2	
PIO_B1	12	-	-	-	-	3	
PIO_B2	11	-	-	-	-	4	
PIO_B3	10	-	-	-	-	5	
PIO_B4	15	-	-	-	-	6	
PIO_A1	2	1	-	-	-	-	
PIO_B5	14	2	-	-	-	-	
PIO_A2	1	-	1	-	-	-	
PIO_B6	13	-	2	-	-	-	
PIO_A3	6	-	-	1	-	-	
PIO_B7	18	-	-	2	-	-	
PIO_A4	5	-	-	-	1	-	
PIO_C0	17	-	-	-	2	-	
GND	19	8, 9	8, 9	8, 9	8, 9	7, 8, 9	

Table 3 : Cable Type 3 Interconnections

- Quantity: 1
- Length: TBM
- Cable: M-Module cable 05M000-01
- Connectors: Five 9 pin female DSUBs with metalized plastic covers and screw type fixations.

5.2. Load Cells

Signal Name	4 p LEMO Pin #	Line Colour
+ Excitation	1	Red
- Excitation	2	black
+ Signal	3	green
- Signal	4	white
Shield	Connector Body	-

Table 4 : Load Cell Cable Wiring

- Quantity: 60
- Cable length: TBM at the telescope cage and mirror cell.
- Connector: LEMO type FGG.0B.304.CLAD42.
- Cable: FUTEK F2562 (signal Cable) 26 AWG 4 Conductor Braided Shield Teflon Cable.

5.3. Pneumatic Valves

Signal Name	4 p SMC Pin #	Phoenix Pin #	Line Colour
+24V	1	4	white
GND	4	2	brown
Input	2	3	yellow
Monitor	3	1	green

Table 5: Valves Cable Wiring

- Quantity: 18
- Length: TBM
- Cable: 0.24mm² four conductors with shield.
- Connectors: Eighteen pairs of SMC Valve connectors and Phoenix type 1850686.

NOTE: Cable shield connected to ground at both ends.

5.4. Inclinometers

Signal Name	Inclinometer Body solder Terminal	Phoenix Pin #	Line Colour
+15V	A	3	white
-15V	B	4	yellow
GND	C	2	brown
Signal	D	1	green

Table 6 : Inclinometers Cable Wiring

- Quantity: 2
- Length: TBM
- Cable: 0.24mm² four conductors with shield.
- Connector: Two Phoenix type 1850686

NOTE: Cable shield connected to ground at both ends.

5.5. Old System – New System

It was agreed that during the installation of the new system we will keep the possibility to switch back and forth between the old and new systems.
For switching between systems we need:

1 – Change the 60 load cell connections from the actual distributed acquisition modules to the new signal conditioning boards LEMO PCB connectors. Since the load cells terminals are connected to the old modules via screw terminals we will simply prepare extensions (longer than necessary to allow easy swapping and provisional placement of the new equipment) with the same cable type comprising the final LEMO cable

connector at one end and a provisional screw terminal connector on the other, this will allow swapping of the 60 load cells in about 2 hours. After the tests and for the final installation we will just cut the extensions to the exact length at the screw terminal side and do the definitive patching of the extension and load cell cables.

2 – Change the 18 air valve connections. This will be simply accomplished just by preparing the complete new cables without reusing the actual valve side connectors. We will purchase new valve's connectors. The swapping of the valves will be done in about 10 minutes.

3 – Change the 2 Inclinometers. This is 8 solder points and can be accomplished in about 20 minutes.

6. CARRIER BOARDS SETTING AND CONFIGURATION

Carrier Board A201S	M-Module device	Base Address A16	Interrupt Vector
I	/mem0 (M36)	**0xFFFF1000**	112
I	/mem1 (M36)	0xFFFF1200	113
I	/mem2 (M36)	0xFFFF1400	114
I	/mem3 (M36)	0xFFFF1600	115
II	/mem4 (M36)	**0xFFFF1800**	116
II	/mem5 (M37)	0xFFFF1A00	117
II	/mem6 (M37)	0xFFFF1C00	118
II	/mem7 (M37)	0xFFFF1E00	119
III	/mem8 (M36)	**0xFFFF2000**	120
III	/mem9 (M37)	0xFFFF2200	121
III	/mem10 (M37)	0xFFFF2400	122
III	/mem11 (M58)	0xFFFF2600	123

Table 7 : Carrier Board Base Addresses

NOTES:

- The three base addresses presented in bold must be set at the respective carrier board's DIP switches.
- Please refer to [RE3] section 2.3 for a base address setting example.

7. SIGNAL NAMING AND ASSIGNMENTS

In the present section “in” and “out” always mean: as seen from the VME LCU.

7.1. Signal Names

Signal Description	Signal Name
Load Cell amplified analogue in signals n = 1…60	LCn
GND analogue in signal from conditioning module MOD01 (amplifier group LC1…LC15)	GND1
GND analogue in signal from conditioning module MOD02 (amplifiers group LC16…LC30)	GND2
GND analogue in signal from conditioning module MOD03 (amplifiers group LC31…LC45)	GND3
GND analogue in signal from conditioning module MOD04 (amplifiers group LC46…LC60)	GND4
Air Valve Pressure Sensor analogue in signals n = 1…18	AVPSn
Analogue Auxiliary in signals n = 1…2	AUXn
Air Valve Drive analogue out signals n = 1…18	AVDn
LCU Refresh watchdog digital out signal	LCUR
Feedback from LCUR digital in signal	FEED
System Air Pressure < 2.0 bar digital in signal	P20
System Air Pressure < 2.8 bar digital in signal	P28
System Air Pressure > 3.2 bar digital in signal	P32
Main Mirror Locally Clamped digital in signal	LOCC
Invert Polarity of MOD01 digital out signal (amplifier group LC1…LC15)	IP1
Feedback from IP1 digital in signal	IP1F
Invert Polarity of MOD02 digital out signal (amplifiers group LC16…LC30)	IP2
Feedback from IP2 digital in signal	IP2F
Invert Polarity of MOD03 digital out signal (amplifiers group LC31…LC45)	IP3
Feedback from IP3 digital in signal	IP3F
Invert Polarity of MOD04 digital out signal (amplifiers group LC46…LC60)	IP4
Feedback from IP4 digital in signal	IP4F

Table 8 : Signal Names

7.2. Signal Assignments

M-Module Device (type)	Mezzanine Port Name (signal type/dir)	Real World Signal Name	Logic
/mem0 (M36)	I0…I14 (A in)	LC1…LC15	-
/mem0 (M36)	I15 (A in)	GND1	-
/mem1 (M36)	I0…I14 (A in)	LC16…LC30	-
/mem1 (M36)	I15 (A in)	GND2	-
/mem2 (M36)	I0…I14 (A in)	LC31…LC45	-
/mem2 (M36)	I15 (A in)	GND3	-
/mem3 (M36)	I0…I14 (A in)	LC46…LC60	-
/mem3 (M36)	I15 (A in)	GND4	-
/mem4 (M36)	I0…I9 (A in)	AVPS1…AVPS10	-
/mem4 (M36)	I10 (A in)	AUX1	-
/mem5 (M37)	V0…V3 (A out)	AVD1…AVD4	-
/mem6 (M37)	V0…V3 (A out)	AVD5…AVD8	-
/mem7 (M37)	V0…V1 (A out)	AVD9…AVD10	-
/mem8 (M36)	I0…I7 (A in)	AVPS11…AVPS18	-
/mem8 (M36)	I10 (A in)	AUX2	-
/mem9 (M37)	V0…V3 (A out)	AVD11…AVD14	-
/mem10 (M37)	V0…V3 (A out)	AVD15…AVD18	-
/mem11 (M58)	PIO_A0 (D out)	LCUR	Active high
/mem11 (M58)	PIO_B0 (D in)	FEED	Active high
/mem11 (M58)	PIO_B1 (D in)	P20	Active high
/mem11 (M58)	PIO_B2 (D in)	P28	Active high
/mem11 (M58)	PIO_B3 (D in)	P32	Active high
/mem11 (M58)	PIO_B4 (D in)	LOCC	Active high
/mem11 (M58)	PIO_A1 (D out)	IP1	Active high
/mem11 (M58)	PIO_B5 (D in)	IP1F	Active high
/mem11 (M58)	PIO_A2 (D out)	IP2	Active high
/mem11 (M58)	PIO_B6 (D in)	IP2F	Active high
/mem11 (M58)	PIO_A3 (D out)	IP3	Active high
/mem11 (M58)	PIO_B7 (D in)	IP3F	Active high
/mem11 (M58)	PIO_A4 (D out)	IP4	Active high
/mem11 (M58)	PIO_C0 (D in)	IP4F	Active high

Table 9 : Signal Assignments

8. Mirror Displacement Measuring System

The lateral pad control system utilizes an apparatus for measuring the mirror's radial displacement. Three standard Mitutoyo linear encoders (linear gages) are mounted in the Cassegrain hole of the mirror opposed at 120 degrees.

The Mitutoyo gages are acquired by a Mitutoyo electronic acquisition and multiplexing box that delivers the values via an RS232 channel.

We will interface the RS232 link to the VME system via VME CPU serial port 2, 3 or 4 (all three available at the MVME 712 transition module). Although in principle this should work perfectly just by redirecting the VLT software serial driver to one of these ports it is not yet 100% confirmed by the software department. In case of problems, alternatively, we will install an ISER12 on a reserved slot of the VME chassis.

9. DRAWING and SCHEMATIC DIAGRAM APPENDIX

The drawings and circuit schematic diagrams are listed below and annexed to this document as nineteen A4 format sheets, starting on next page.

9.1. Block Diagram

9.2. Board Type 1 Power Supplies

9.3. Board Type 1 Analogue and Digital connection

9.4. Board Type 1 Signal Amplifiers 1 to 4

9.5. Board Type 1 Signal Amplifiers 5 to 8

9.6. Board Type 1 Signal Amplifiers 9 to 12

9.7. Board Type 1 Signal Amplifiers 13 to 15

9.8. Board Type 2 Power Supplies

9.9. Board Type 2 Analogue connection

9.10. Board Type 2 Valves and Inclinometer connection

9.11. Board Type 3 Power Supplies

9.12. Board Type 3 Connection and Relays

9.13. Board Type 3 Window Comparators

9.14. Board Type 3 Watch Dog and Logic

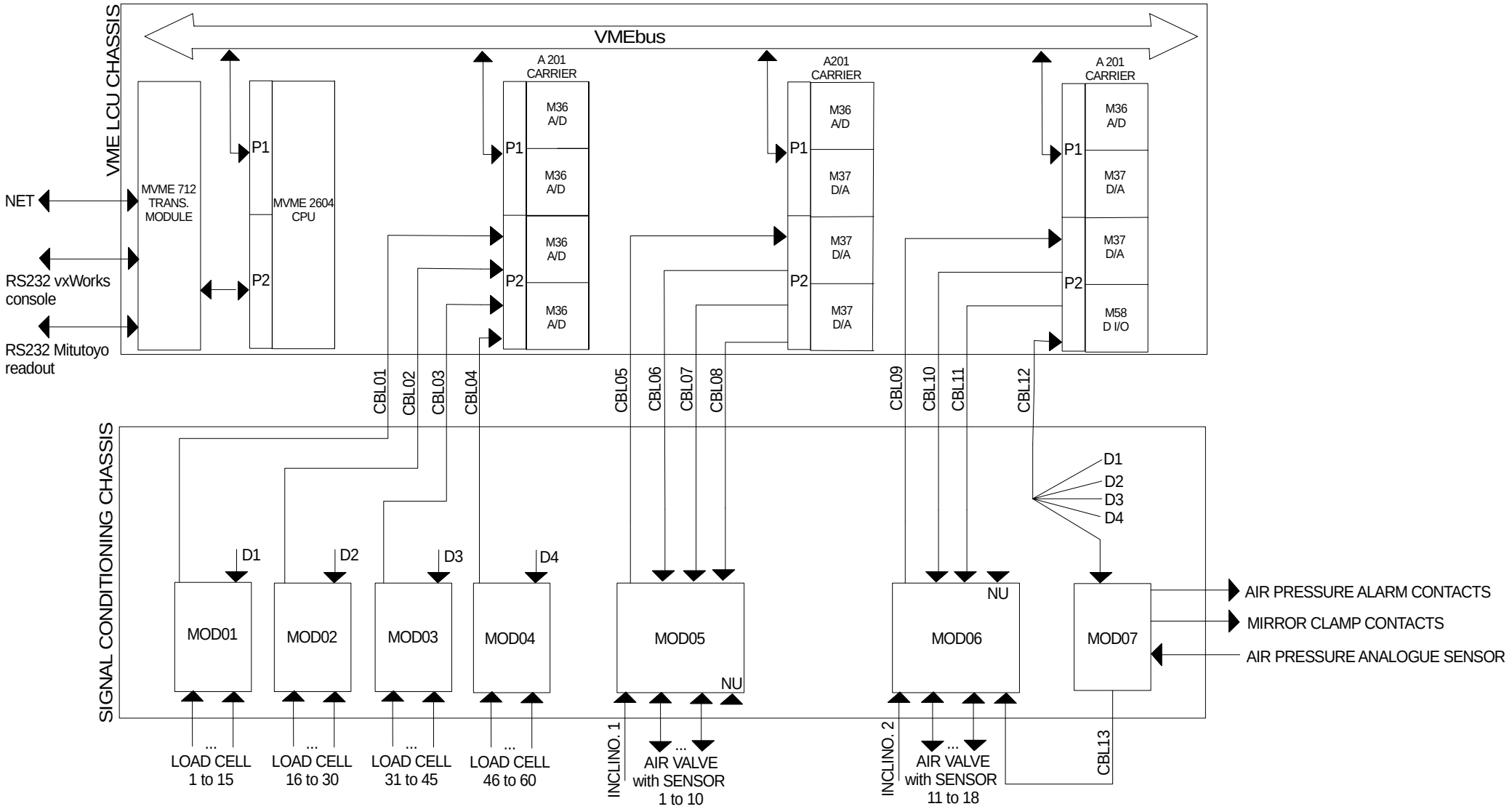
9.15. VME LCU Chassis Drawing #1

9.16. VME LCU Chassis Drawing #2

9.17. VME LCU Chassis Drawing #3

9.18. Signal Conditioning Chassis Drawing #1

9.19. Signal Conditioning Chassis Drawing #2



					Date	Init.
				Drawn	27/05/06	JA
				Chckd.		
				Appr.		

European Southern Observatory
3P6 Lateral Pads
Control Electronics

Title: Block Diagram

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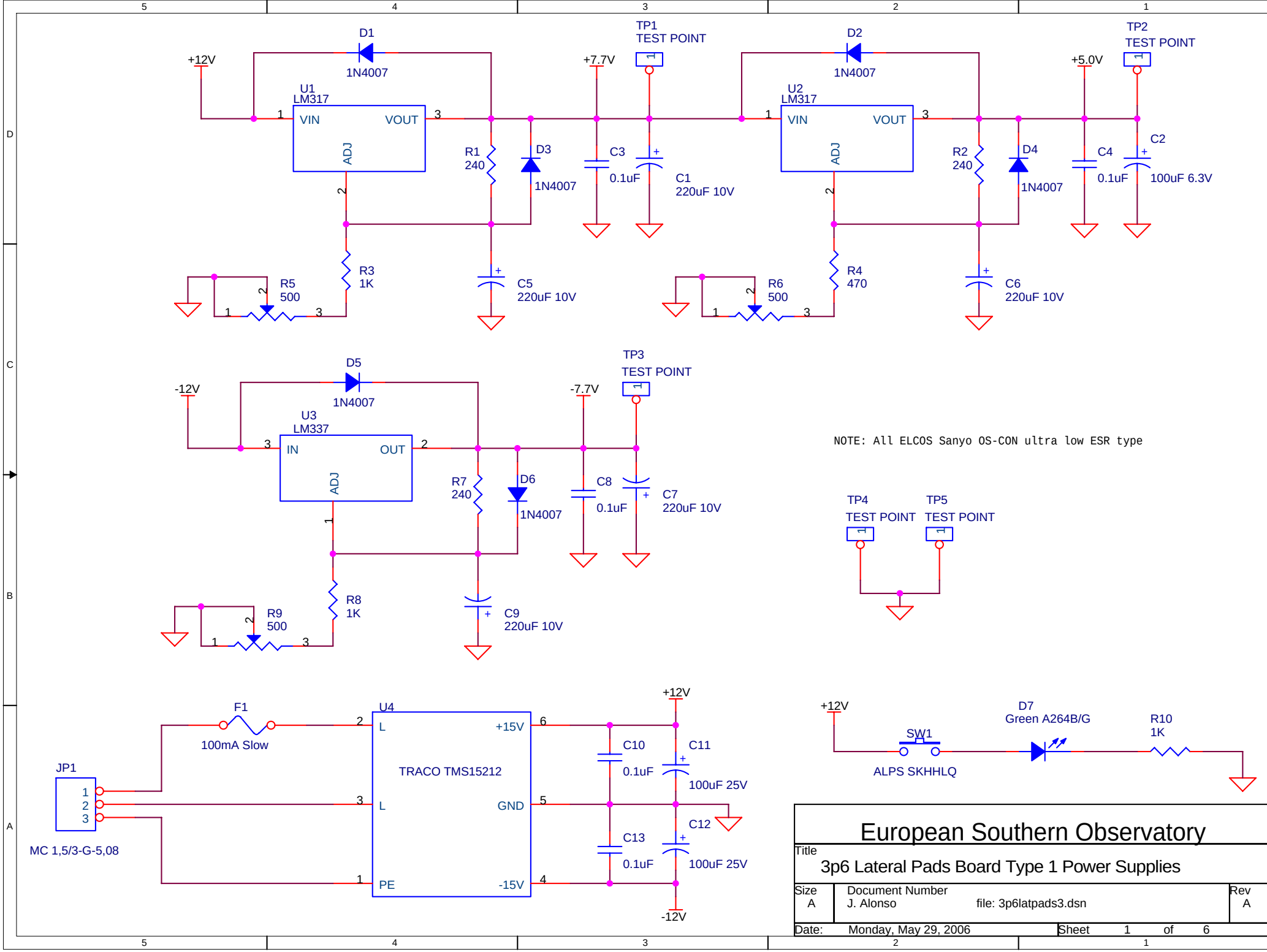
Issue	Revisions	Date	Init
1	FDR	27/05/06	JA

Document Number: 3P6-DSD-ESO-60400-0006

File Name: FDR_BK1.SKF



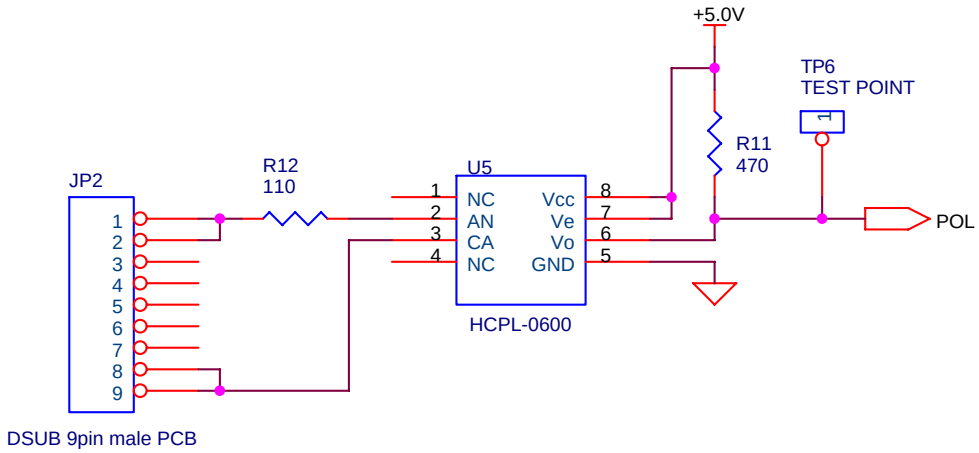
European Southern Observatory

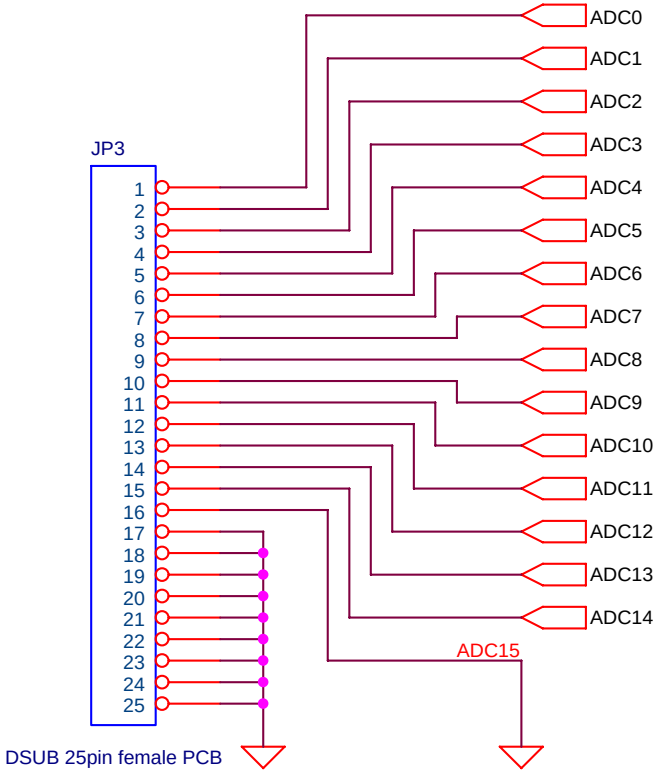
Title: 3p6 Lateral Pads Board Type 1 Power Supplies

Size	Document Number	Rev
A	J. Alonso file: 3p6latpads3.dsn	A

Date: Monday, May 29, 2006 Sheet 1 of 6

1 - Invert Polarity - PIO_A1 - b1 (output)
2 - IP feedback - PIO_B5 - b5 (input)
3 - NC
4 - NC
5 - NC
6 - NC
7 - NC
8 - GND - PIO_C4 - c7
9 - GND - PIO_C7 - c8



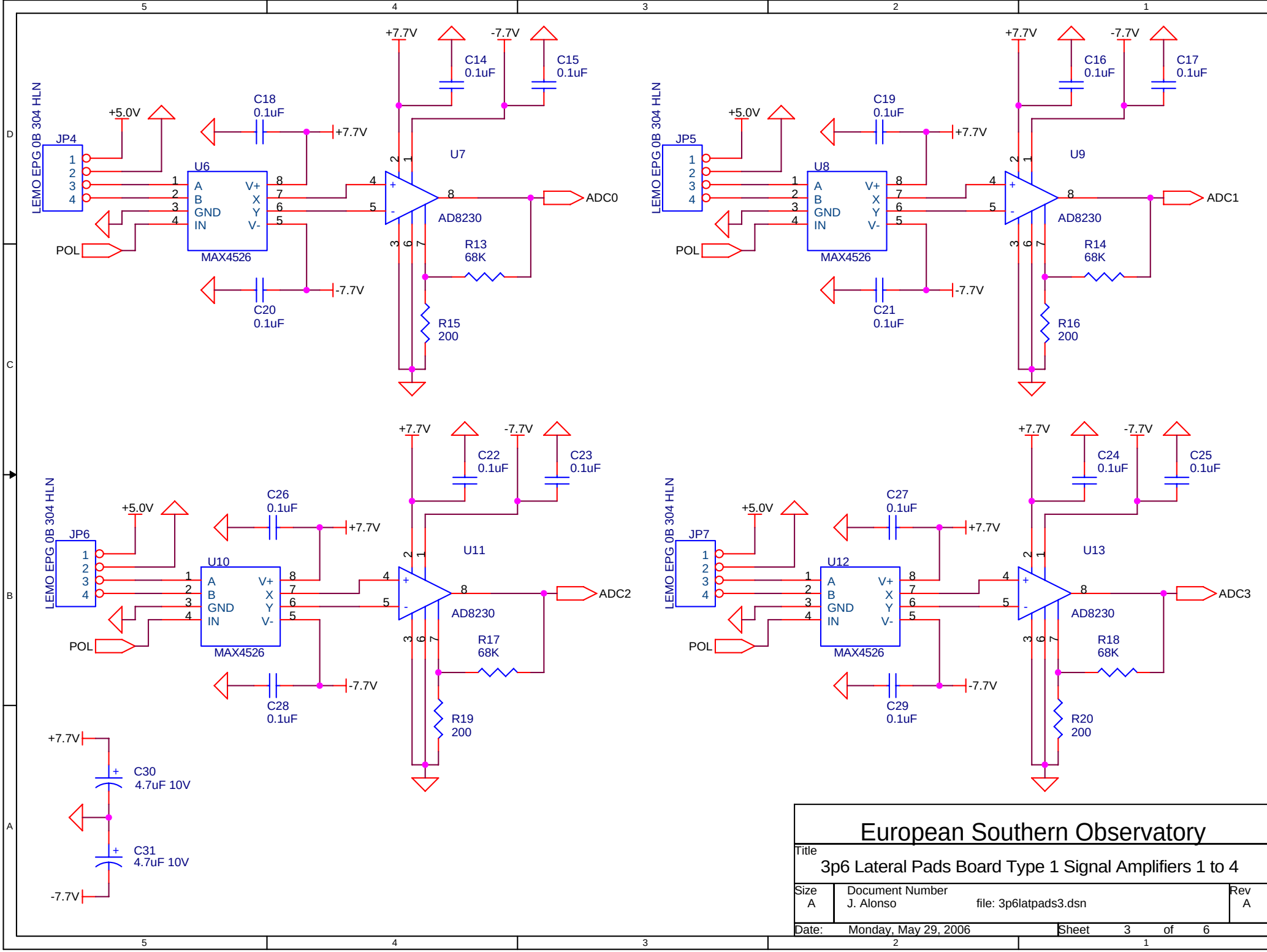


European Southern Observatory

Title: 3p6 Lat. Pads Board Type 1 Analogue and Digital Conn.

Size	Document Number	Rev
A	J. Alonso file: 3p6latpads3.dsn	A

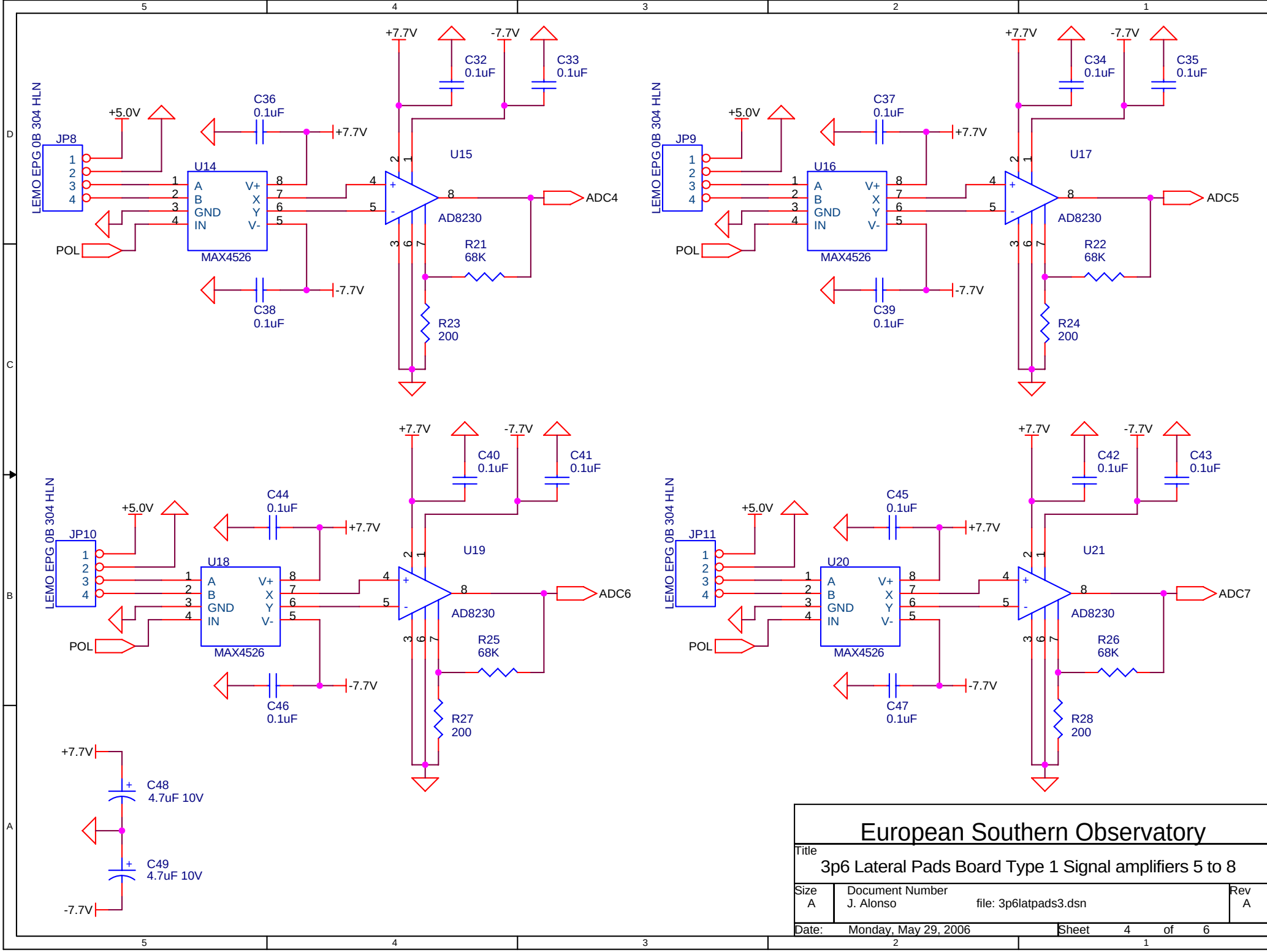
Date: Monday, May 29, 2006 Sheet 2 of 6



European Southern Observatory

Title: 3p6 Lateral Pads Board Type 1 Signal Amplifiers 1 to 4

Size	Document Number	Rev
A	J. Alonso file: 3p6latpads3.dsn	A
Date: Monday, May 29, 2006	Sheet 3 of 6	

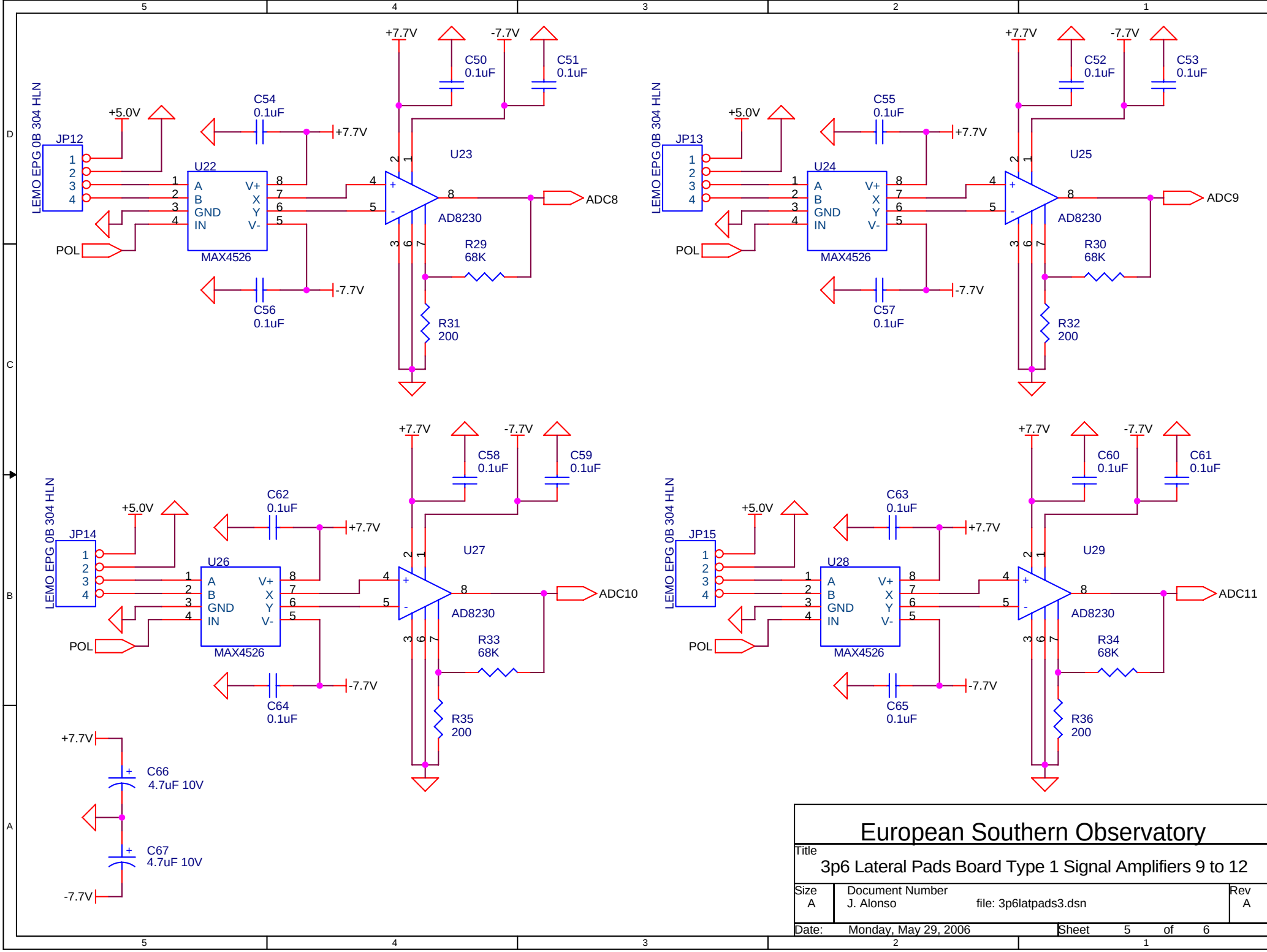


European Southern Observatory

Title: 3p6 Lateral Pads Board Type 1 Signal amplifiers 5 to 8

Size	Document Number	Rev
A	J. Alonso file: 3p6latpads3.dsn	A

Date: Monday, May 29, 2006 Sheet 4 of 6

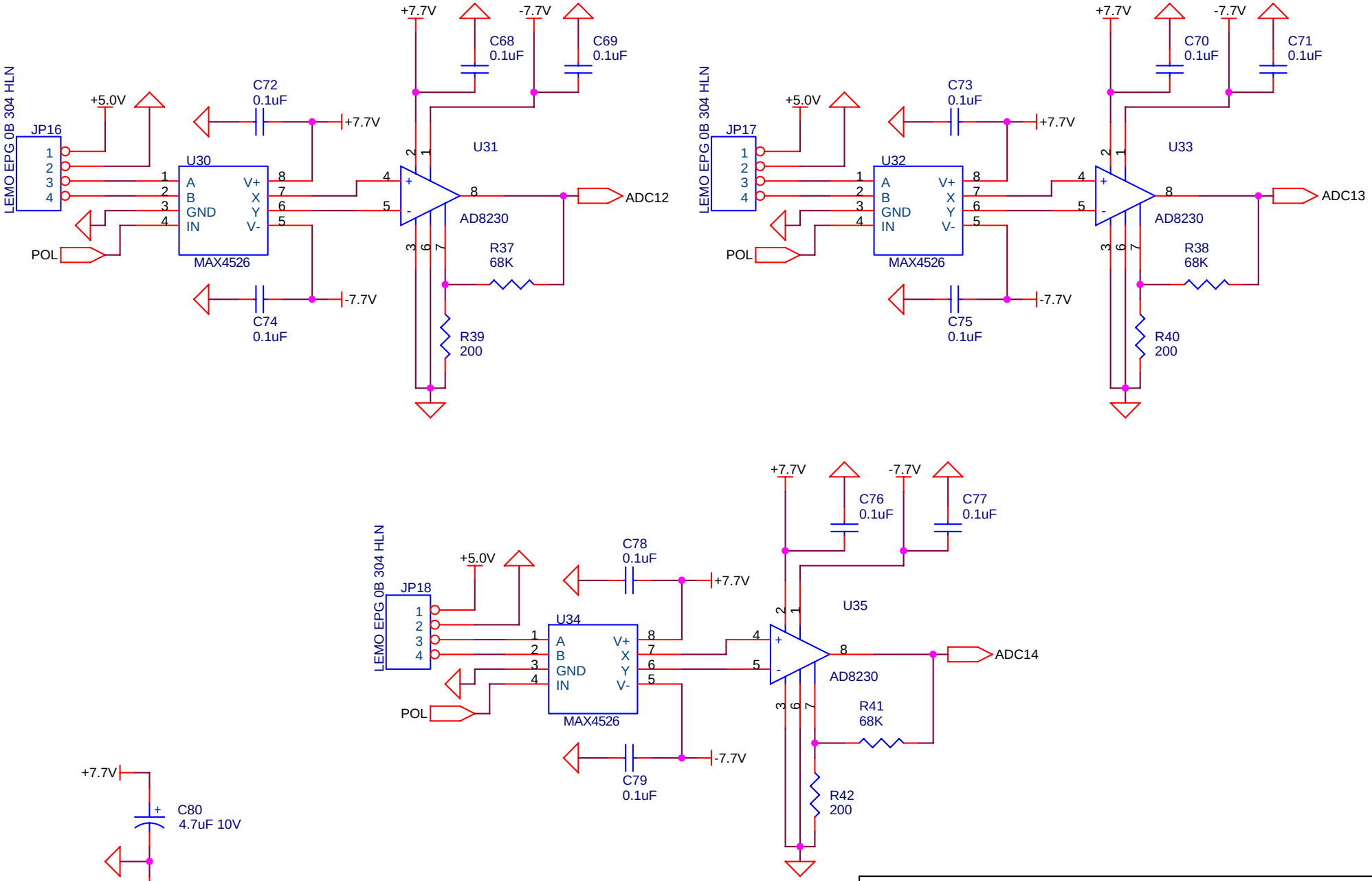


European Southern Observatory

Title: 3p6 Lateral Pads Board Type 1 Signal Amplifiers 9 to 12

Size	Document Number	Rev
A	J. Alonso file: 3p6latpads3.dsn	A

Date: Monday, May 29, 2006 Sheet 5 of 6

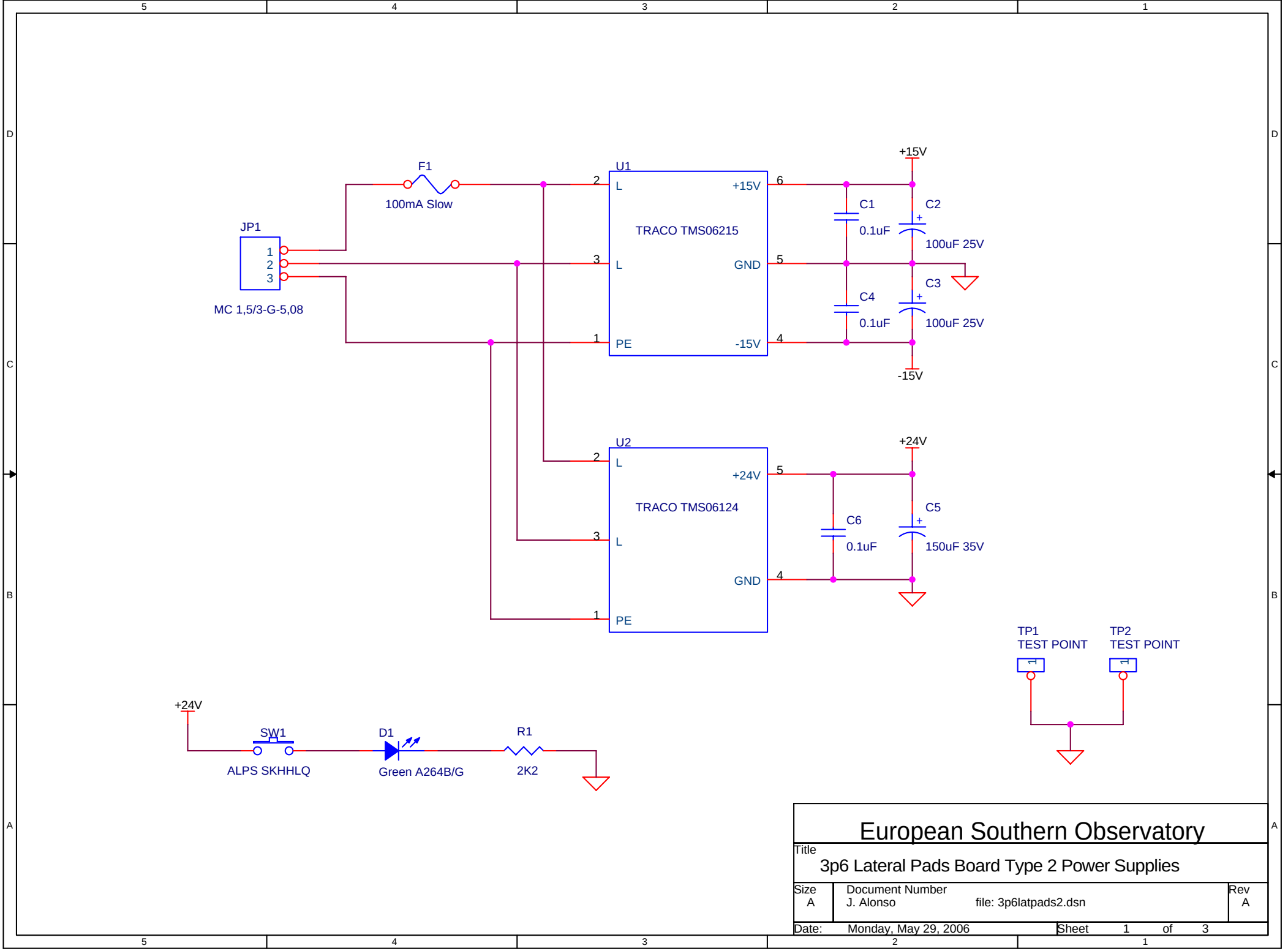


European Southern Observatory

Title: 3p6 Lateral Pads Board Type 1 Signal Amplifiers 13 to 15

Size	Document Number	Rev
A	J. Alonso file: 3p6latpads3.dsn	A

Date: Monday, May 29, 2006 Sheet 6 of 6

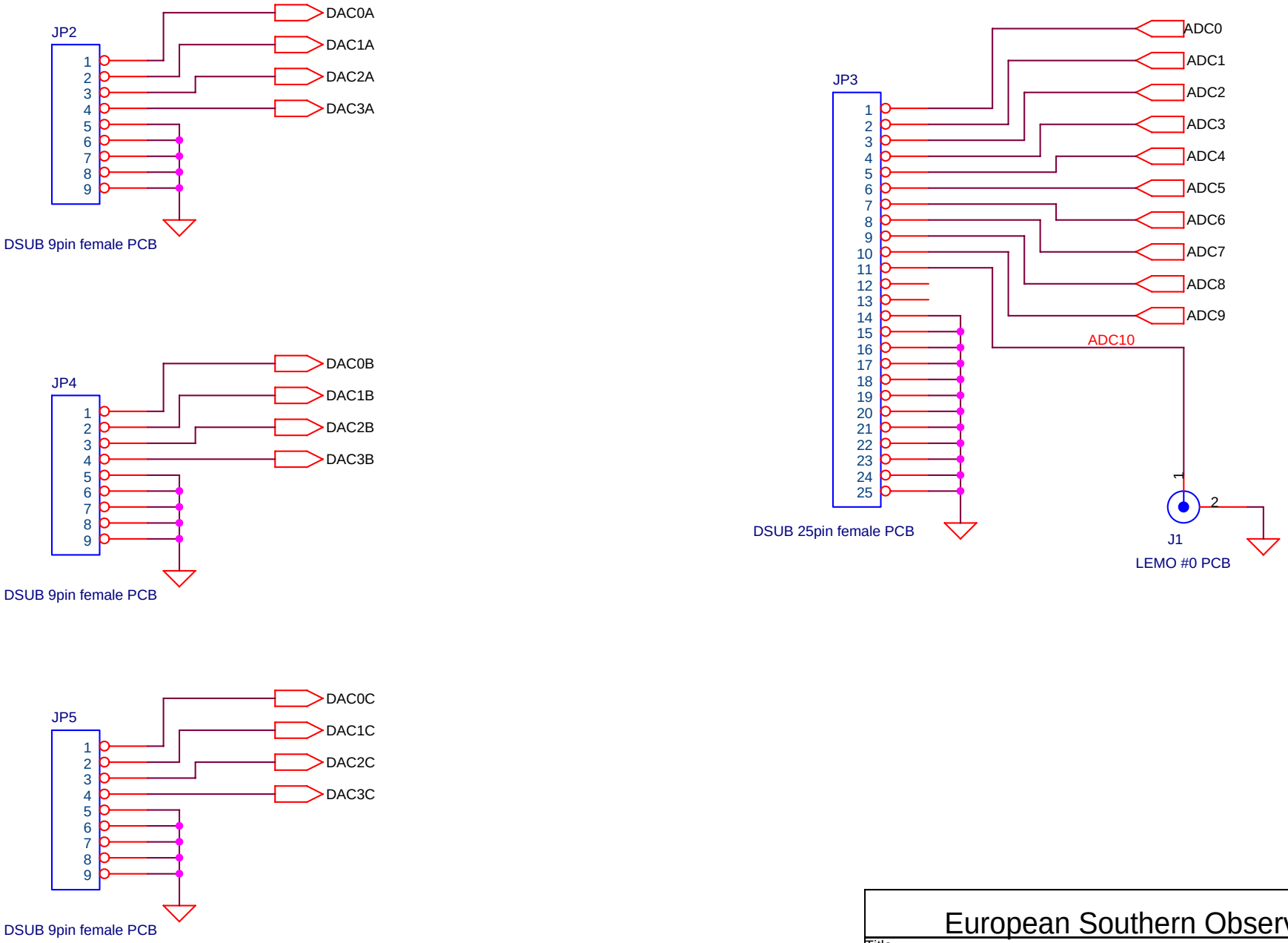


European Southern Observatory

Title
3p6 Lateral Pads Board Type 2 Power Supplies

Size	Document Number	Rev
A	J. Alonso file: 3p6latpads2.dsn	A

Date: Monday, May 29, 2006 Sheet 1 of 3

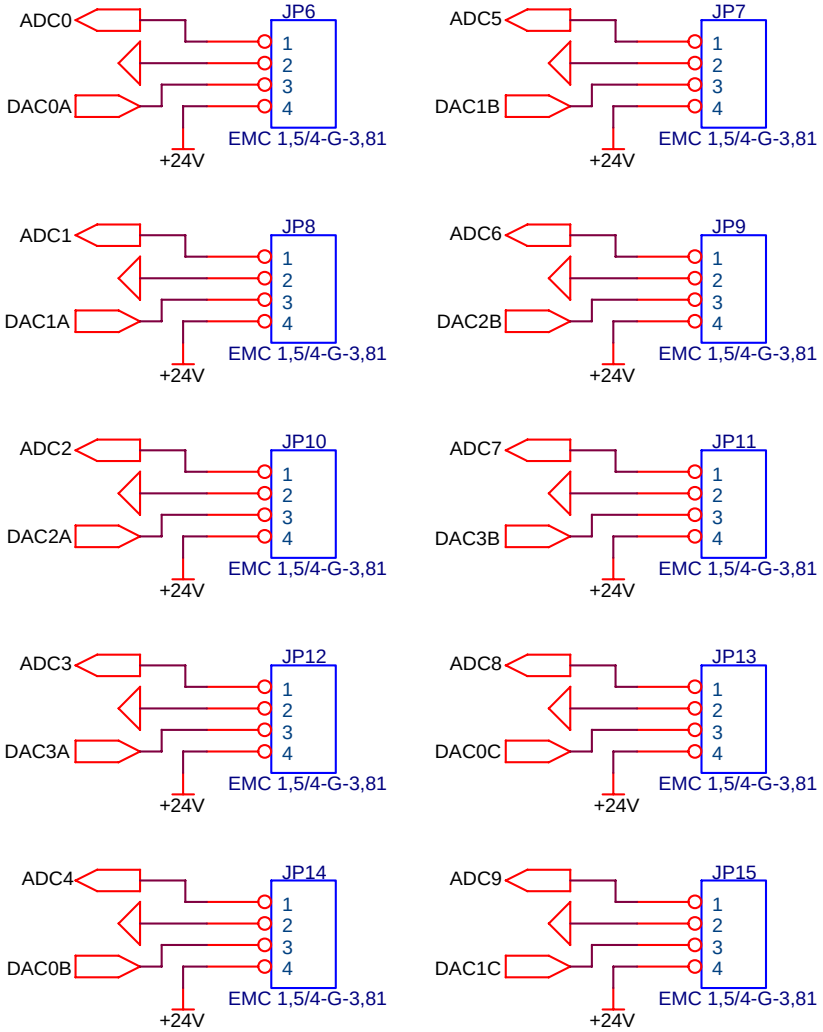


European Southern Observatory

Title: 3p6 Lateral Pads Board Type 2 Analogue Connection

Size	Document Number	Rev
A	J. Alonso file: 3p6latpads2.dsn	A

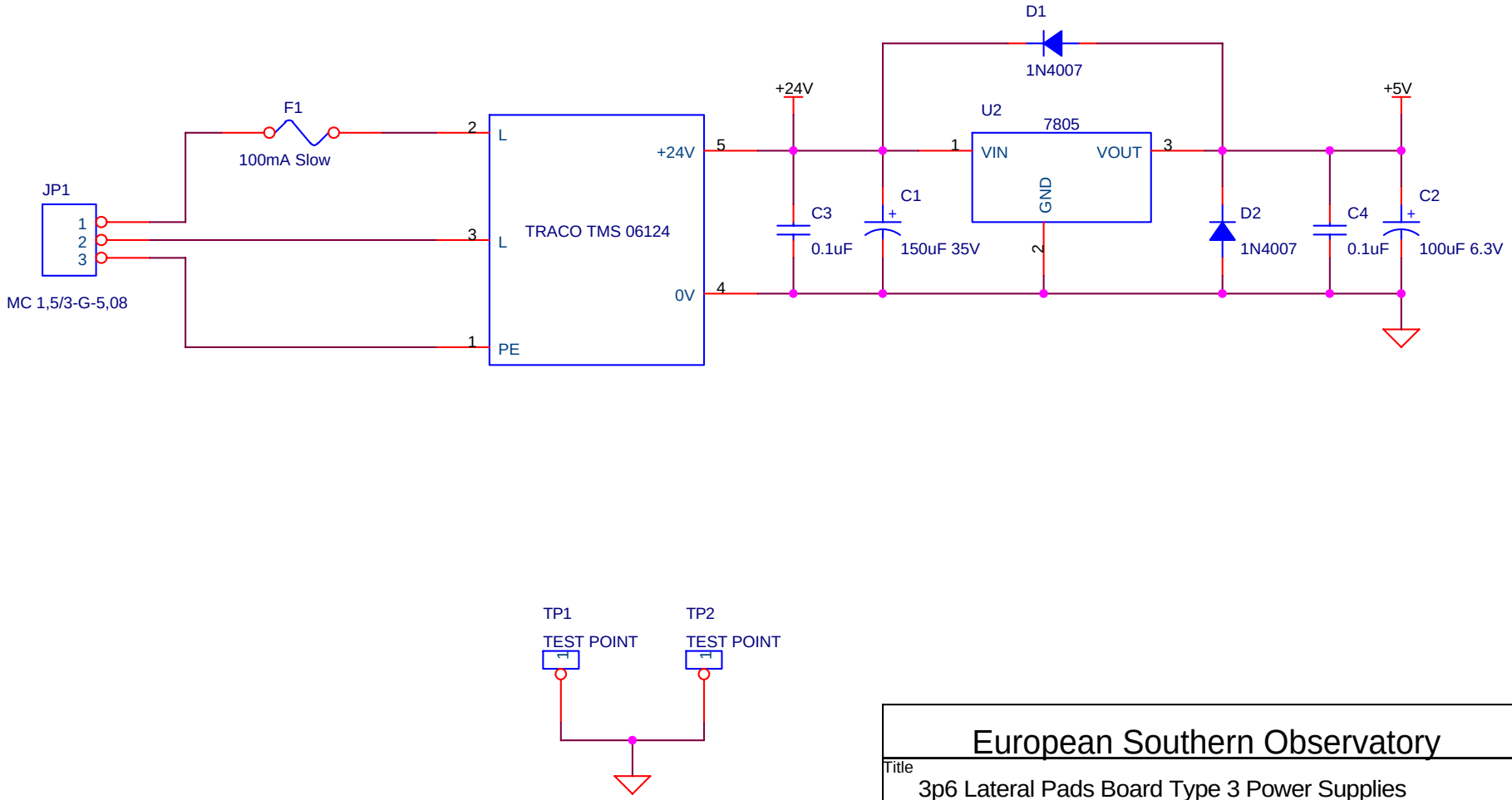
Date: Monday, May 29, 2006 Sheet 2 of 3



European Southern Observatory

Title
3p6 Lat. Pads Board Type 2 Valves and Inclinometer Conn.

Size	Document Number	Rev
A	J. Alonso file: 3p6latpads2.dsn	A
Date: Monday, May 29, 2006	Sheet 3 of 3	



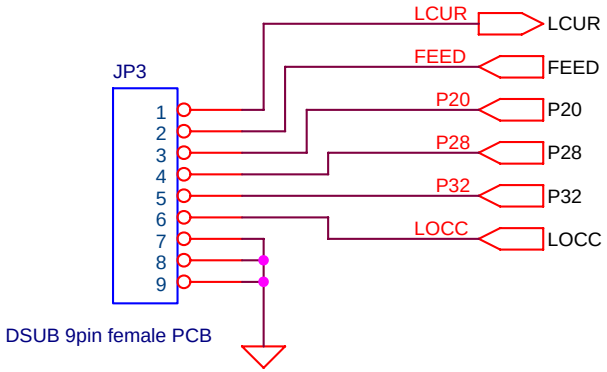
European Southern Observatory

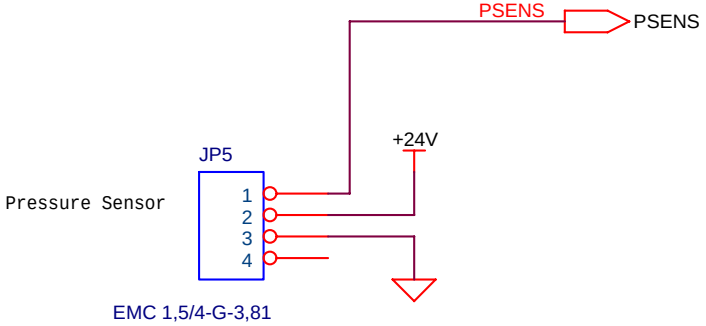
Title
3p6 Lateral Pads Board Type 3 Power Supplies

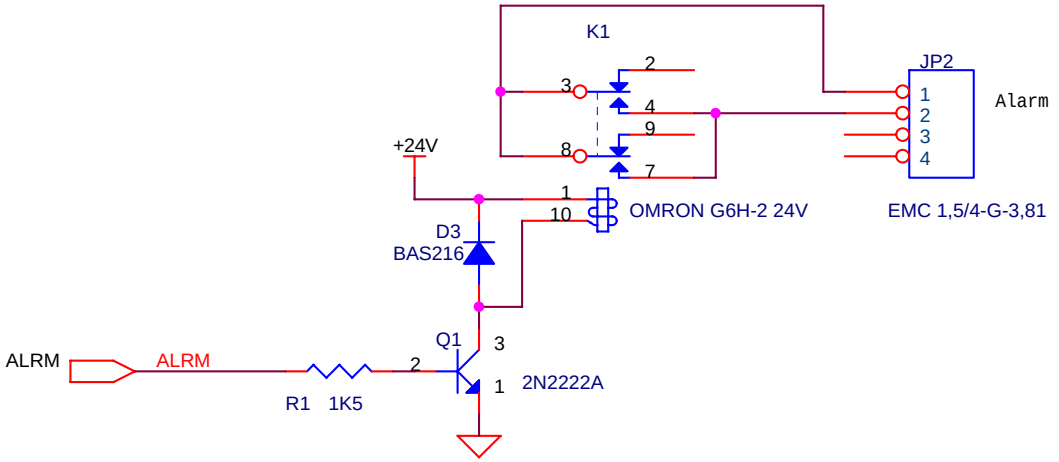
Size	Document Number	Rev
A	J. Alonso file: 3p6latpads1.dsn	A

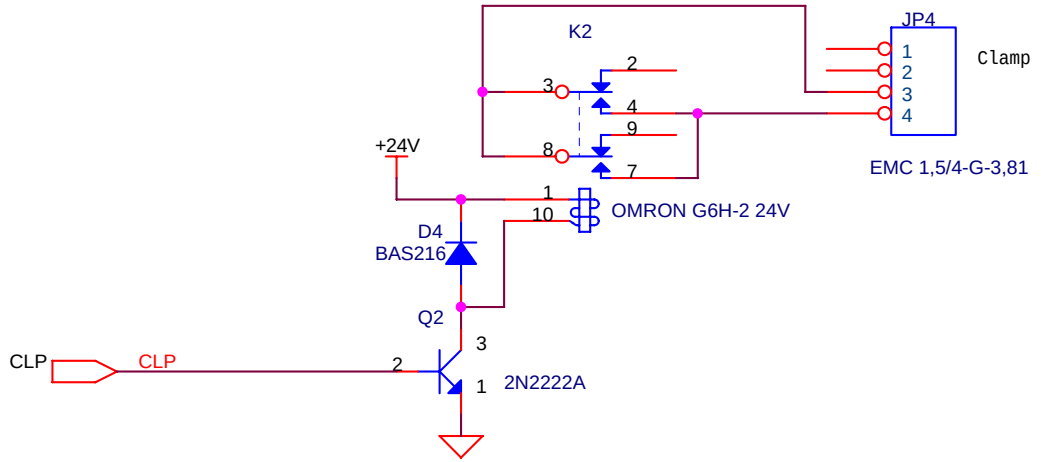
Date: Monday, May 29, 2006 Sheet 1 of 4

```
--- Digital I/O JP2 Connector ---

1 - Refresh Watch Dog - PIO_A0 - a1 (output)
2 - Refresh Feedback - PIO_B0 - c3 (input)
3 - > 3,2 bar - PIO_B1 - a4 (input)
4 - < 2,8 bar - PIO_B2 - b4 (input)
5 - < 2,0 bar - PIO_B3 - c4 (input)
6 - Locally Clamped - PIO_B4 - a5 (input)
7 - GND
8 - GND - PIO_C4 - c7
9 - GND - PIO_C7 - c8

All input and output signals active high.
```







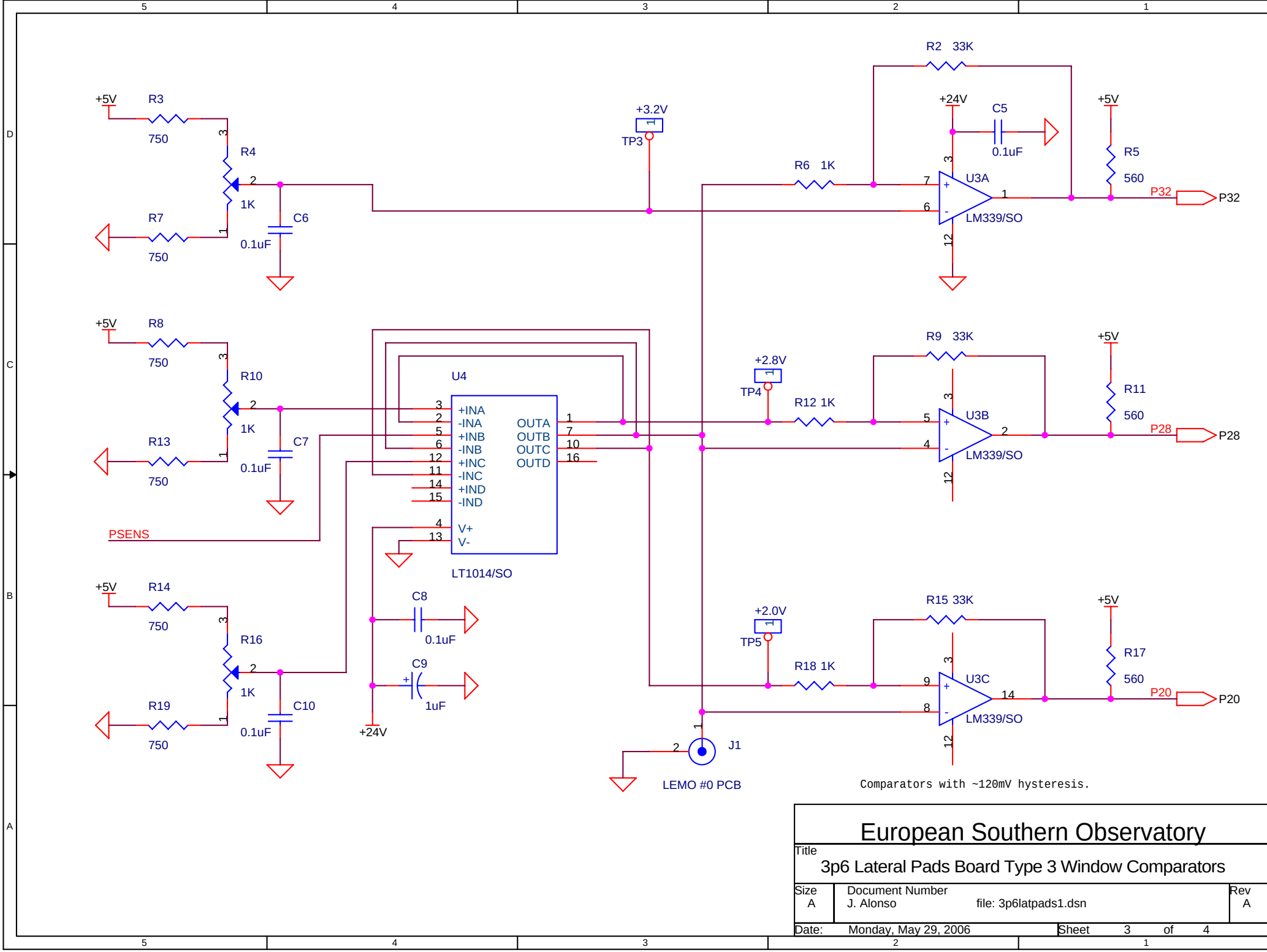


European Southern Observatory

Title: 3p6 Lateral Pads Board Type 3 Connection and Relays

Size	Document Number	Rev
A	J. Alonso file: 3p6latpads1.dsn	A

Date: Monday, May 29, 2006 Sheet 2 of 4

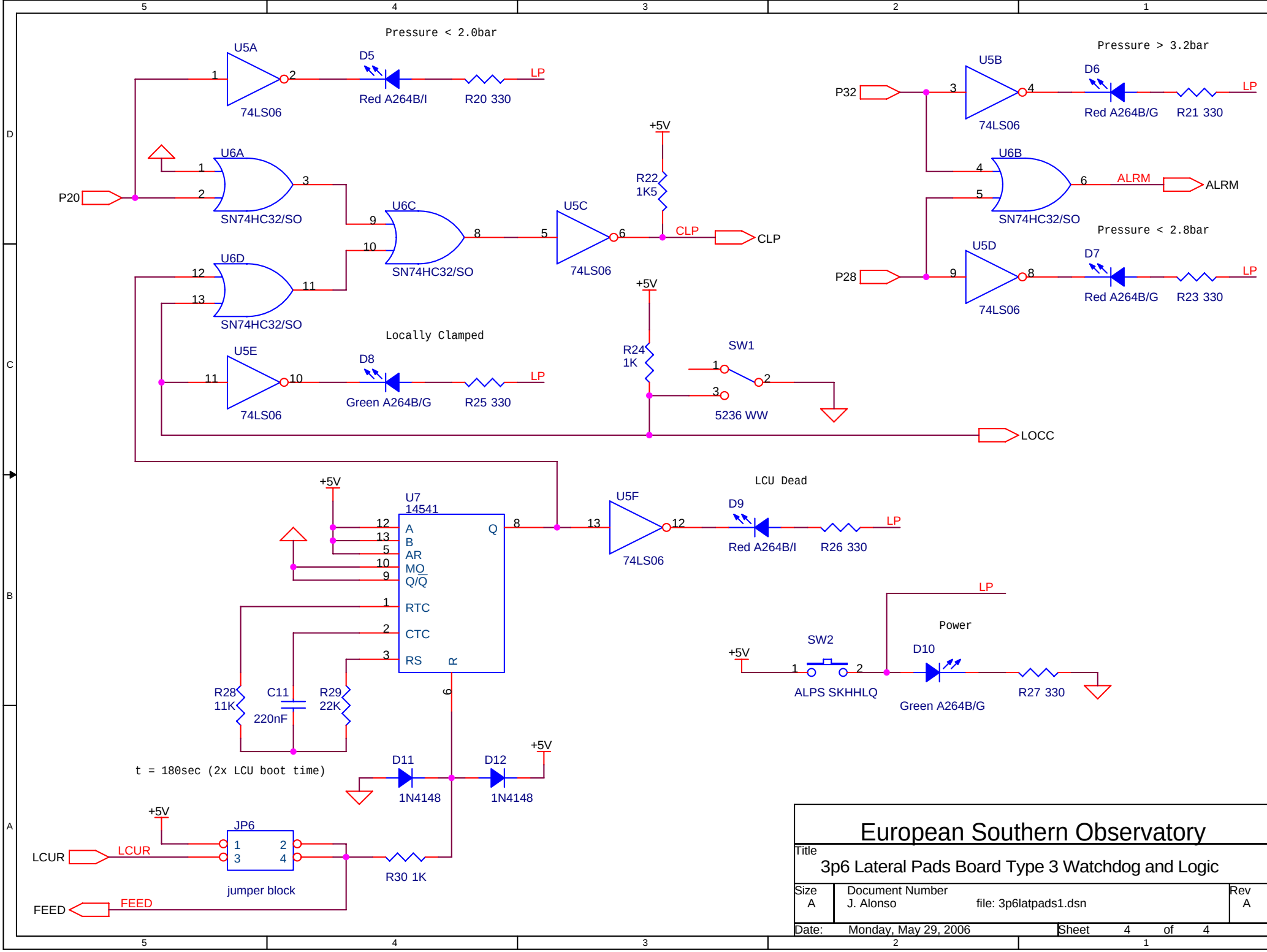


European Southern Observatory

Title: 3p6 Lateral Pads Board Type 3 Window Comparators

Size	Document Number	Rev
A	J. Alonso file: 3p6latpads1.dsn	A

Date: Monday, May 29, 2006 Sheet 3 of 4


Pressure < 2.0bar
U5A
D5
LP
Red A264B/I
R20 330
74LS06
P20
U6A
SN74HC32/SO
U6C
SN74HC32/SO
U5C
74LS06
+5V
R22
1K5
CLP
U6D
SN74HC32/SO
Locally Clamped
U5E
D8
Green A264B/G
R25 330
74LS06
R24
1K
SW1
5236 WW
LOCC
Pressure > 3.2bar
U5B
D6
Red A264B/G
R21 330
74LS06
P32
U6B
ALRM
SN74HC32/SO
Pressure < 2.8bar
U5D
D7
Red A264B/G
R23 330
74LS06
P28
U7
14541
A
B
AR
MO
Q/Q
RTC
CTC
RS
Q
R28
11K
C11
220nF
R29
22K
t = 180sec (2x LCU boot time)
U5F
LCU Dead
D9
Red A264B/I
R26 330
74LS06
Power
SW2
ALPS SKHHLQ
D10
Green A264B/G
R27 330
D11
1N4148
D12
1N4148
JP6
jumper block
LCUR
FEED
R30 1K
European Southern Observatory
Title
3p6 Lateral Pads Board Type 3 Watchdog and Logic
Size
A
Document Number
J. Alonso
file: 3p6latpads1.dsn
Rev
A
Date:
Monday, May 29, 2006
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4
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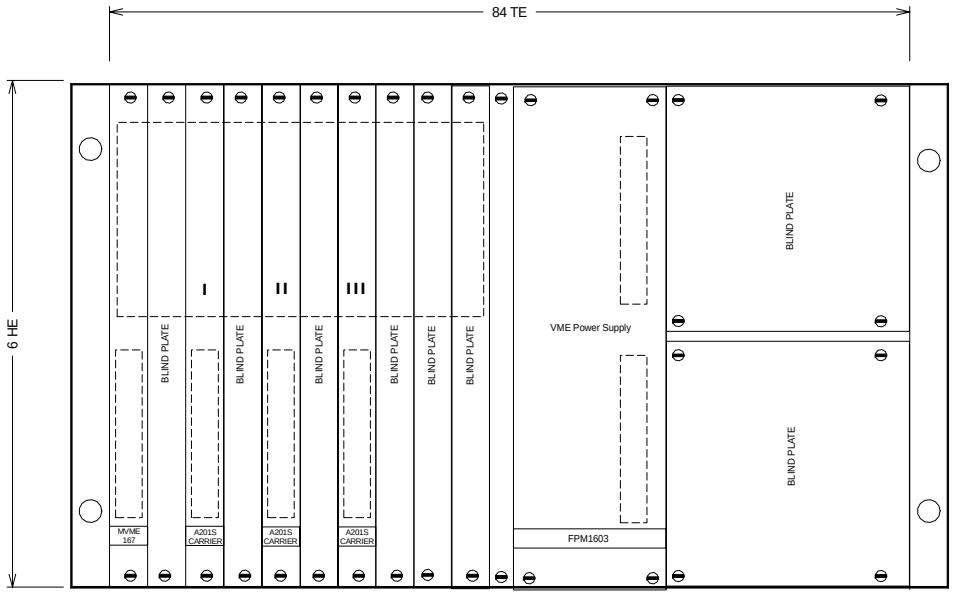
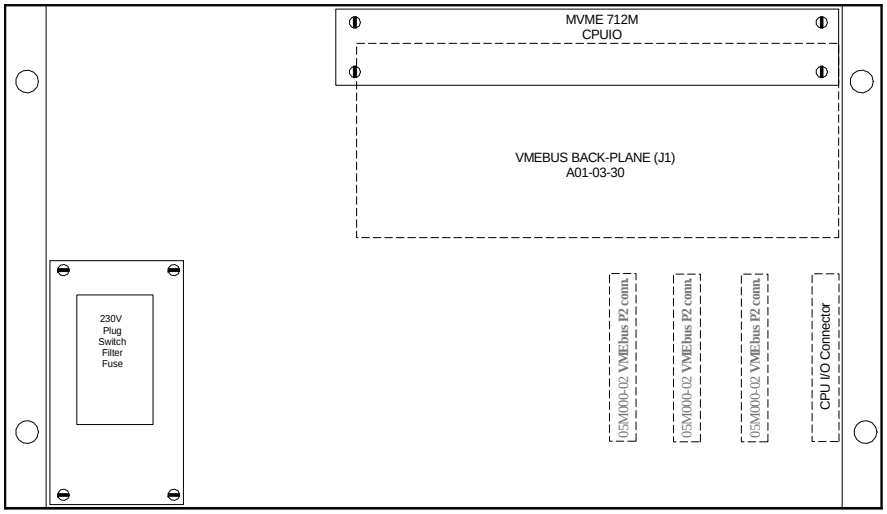
3P6 Lateral Pads LCU

FRONT SIDE VIEW



REAR SIDE VIEW



LEGENDE:

RACK: ESO Standard (minimize depth)
VMEBUS: 10 SLOTS - ACTIVE TERMINATION - AUTO DAISY CHAIN
CPUIO: TRANSITION MODULE MVME 712M
CPU:MOTOROLA - MVME2604 Power PC
I - A201 S-6U Carrier board fitted with 4 M36 A/D mezzanines (MEN).
II - A201 S-6U Carrier board fitted with 1 M36 A/D mezzanine and 3 M37 D/A mezzanines (MEN).
III - A201 S-6U Carrier board fitted with 1 M36 A/D mezzanine 2 M37 D/A mezzanines and 1 M58 32 bit TTL I/O mezzanine (MEN).
VME PS: KNIEL FPM 300W FOR VME BUS SUPPLY

					Date	Init.
				Drawn	28/05/06	JA
				Chckd.		
				Appr.		

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3.6 Lateral Pads
Control Electronics

Title: Lateral Pads LCU
Chassis Layout

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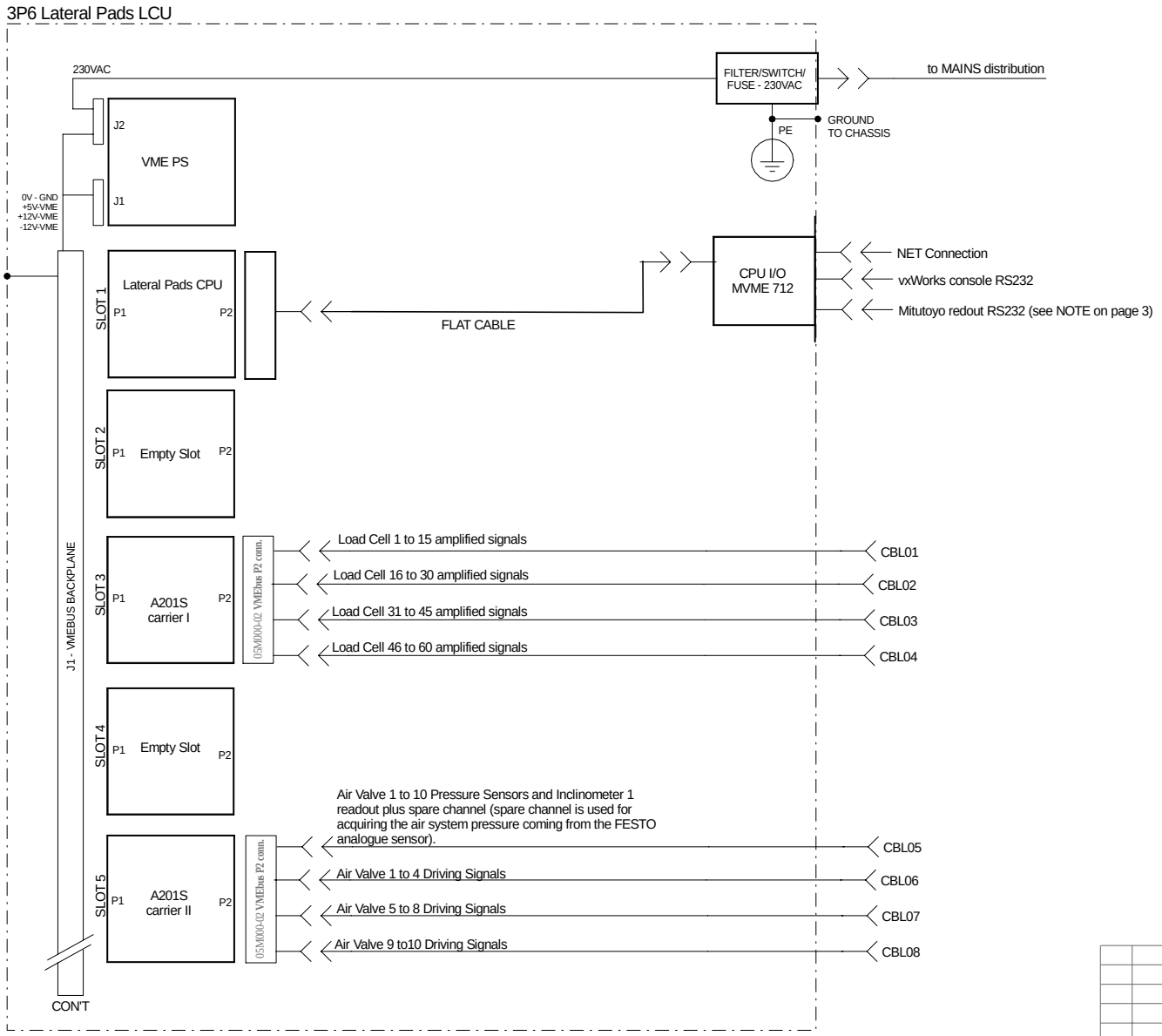
Issue	Revisions	Date	Init
1	FDR	28/05/06	JA

Document Number: 3P6-DSD-ESO-60400-0006

File Name: 3P6latpad-LCU1.skf



					Date	Init.
				Drawn	28/05/06	JA
				Chckd.		
				Appr.		

European Southern Observatory
3.6 Lateral Pads
Control Electronics

Title:
Lateral Pads LCU
Internal Wiring Diagram (Part 1)

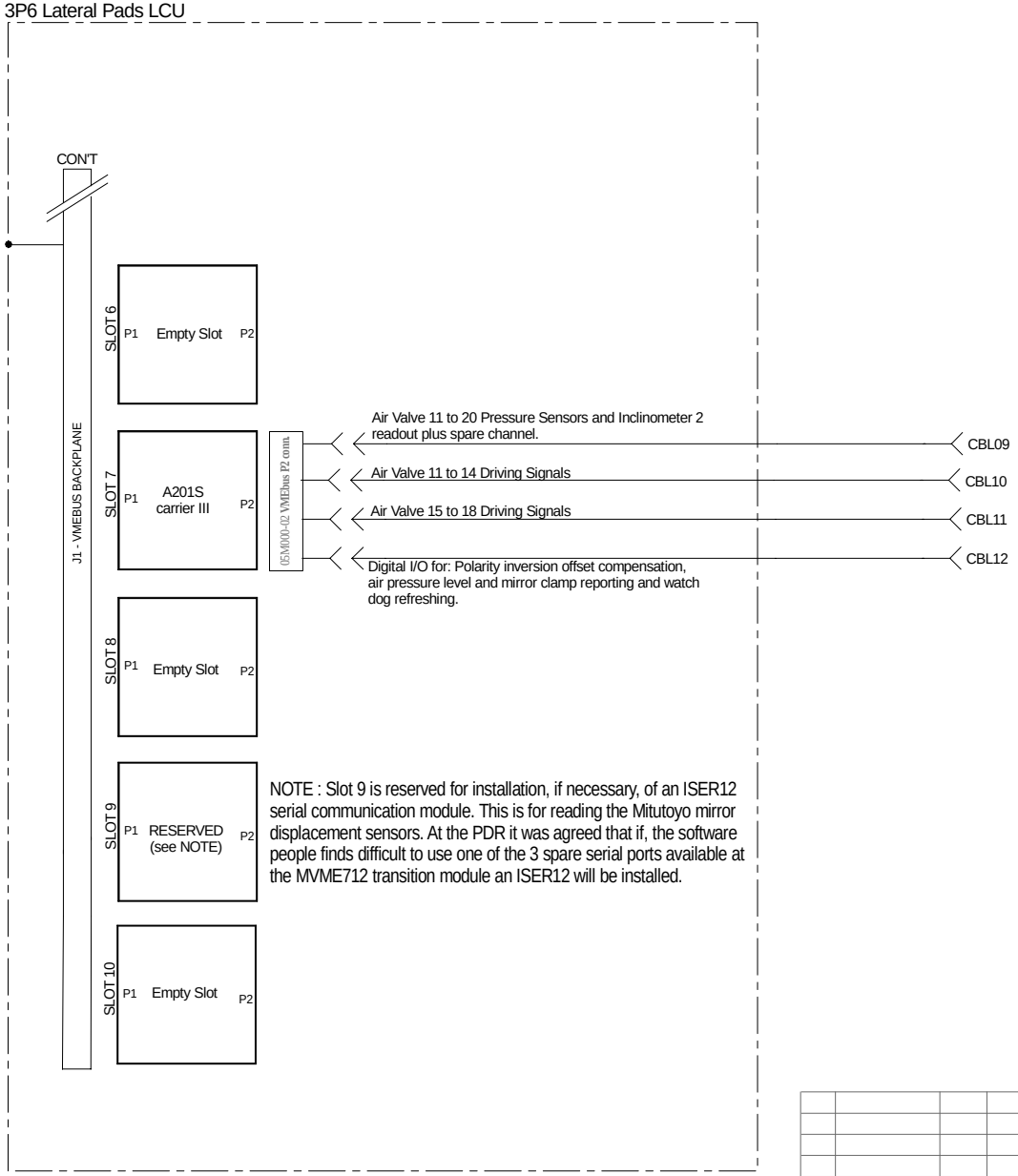
Page 2/3

Issue	Revisions	Date	Init
1	FDR	28/05/06	JA

Document Number: 3P6-DSD-ESO-60400-0006

File Name: 3P6latpad-LCU2.skf

3P6 Lateral Pads LCU



NOTE : Slot 9 is reserved for installation, if necessary, of an ISER12 serial communication module. This is for reading the Mitutoyo mirror displacement sensors. At the PDR it was agreed that if, the software people finds difficult to use one of the 3 spare serial ports available at the MVME712 transition module an ISER12 will be installed.

					Date	Init.
				Drawn	28/05/06	JA
				Chckd.		
				Appr.		

European Southern Observatory
3.6 Lateral Pads
Control Electronics

Title: Lateral Pads LCU
Internal Wiring Diagram (Part 2)

Page 3/3

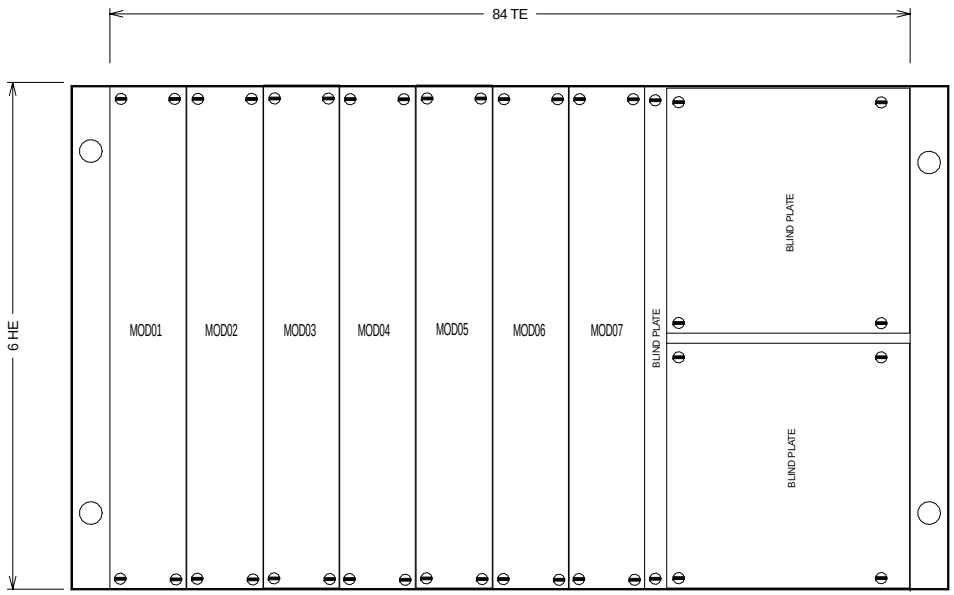
Issue	Revisions	Date	Init
1	FDR	28/05/06	JA

Document Number: 3P6-DSD-ESO-60400-0006

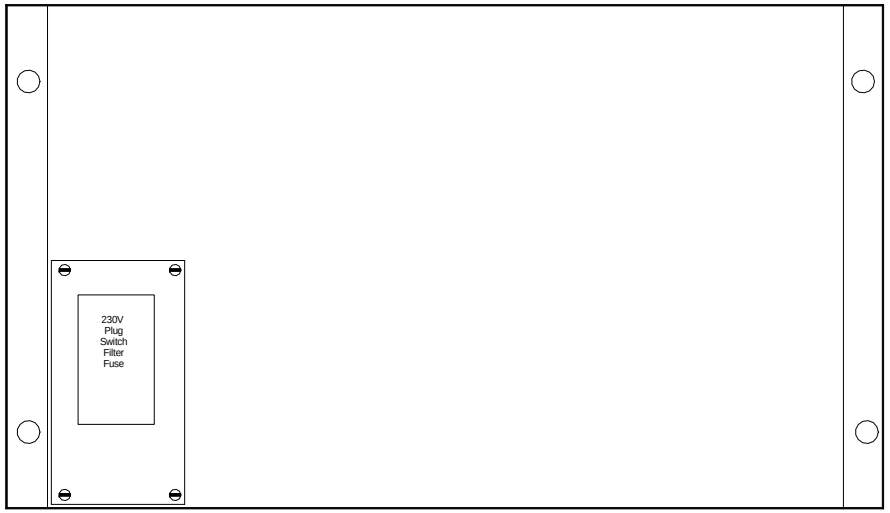
File Name: 3P6latpad-LCU3.skf

3P6 Lateral Pads Signal Conditioning Chassis

FRONT SIDE VIEW



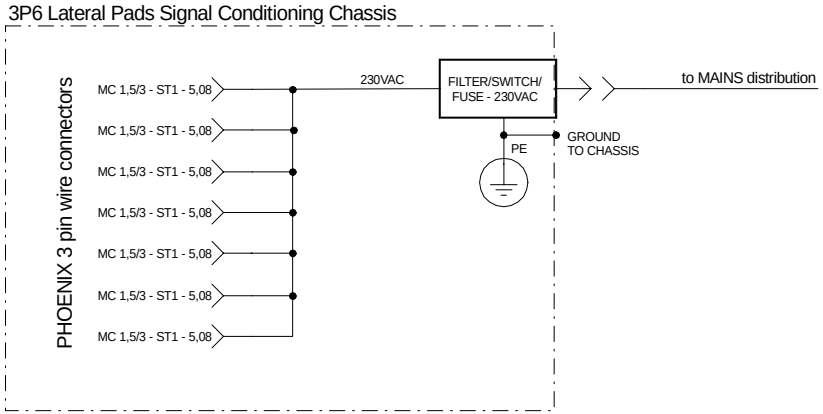
REAR SIDE VIEW



LEGENDE:

RACK: ESO Standard (minimize depth).
MOD01 trough MOD04 board type 1
MOD05 and MOD06 board type 2
MOD07 board type 3

					Date	Init.		
				Drawn	28/05/06	JA	European Southern Observatory 3.6 Lateral Pads Control Electronics	
				Chckd.				
				Appr.				
				Title:	Lateral Pads LCU Signal Conditioning Chassis Layout			Page 1/2
1	FDR	28/05/06	JA	Document Number:	3P6-DSD-ESO-60400-0006		File Name:	3P6latpad-CCH1.skf
Issue	Revisions	Date	Init					



					Date	Init.
				Drawn	28/05/06	JA
				Chckd.		
				Appr.		

European Southern Observatory
3.6 Lateral Pads
Control Electronics

Title: Lateral Pads Signal Conditioning Chassis
Internal Wiring Diagram

Page: 2/3

Issue	Revisions	Date	Init
1	FDR	28/05/06	JA

Document Number: 3P6-DSD-ESO-60400-0006

File Name: 3P6latpad-LCU2.skf