Southern African Large Telescope

SALTICAM

Preliminary Design Review

Document Number 3300AS0002: Interface Control Dossier For SALTICAM

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Table of Contents

1 Scope 4
2 Optical 4
3 Mechanical 4
3.1 Weight Budget 5
3.2 Envelope 5
3.3 Centre of Gravity 9
3.4 Mount Points 11
3.5 Handling Fixtures 11
3.6 Shipping Container 12
4 Electrical 12
4.1 Electrical Power 12
4.2 Electrical Connectors 12
5 Signals 12
6 Dry Air 13
7 Cryogenic and Refrigeration 13
8 Computers and Communications (TBD14) 13
9 Software (TBD14) 14
9.1 Subarrays 14
9.2 Readout Modes 14
9.3 Commands 15
9.4 Telemetry 15
10 Maintenance 15
11 List of TBCs and TBDs 16

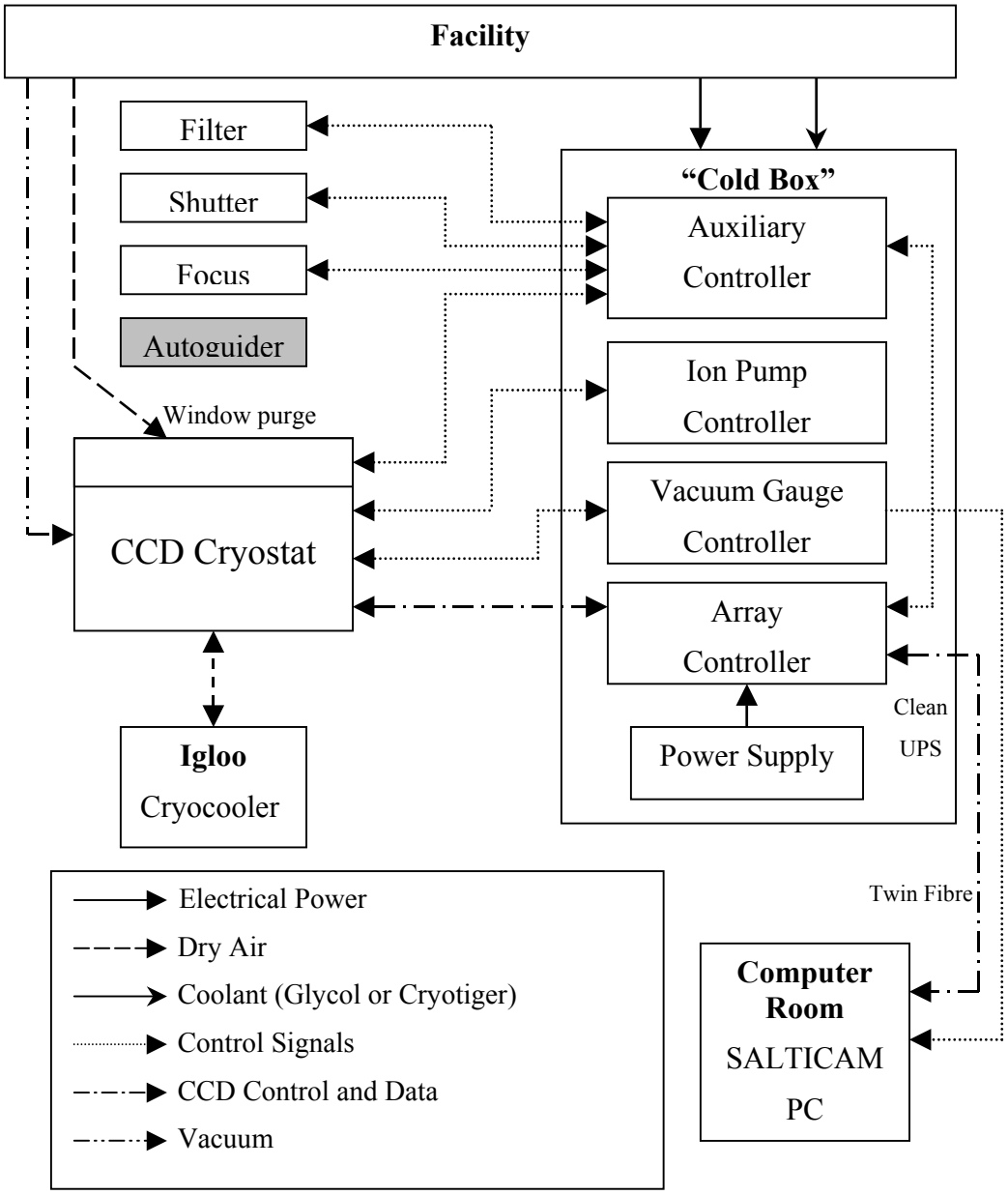


Figure 1: The SALT/SALTICAM interfacing block diagram.

1 Scope

This document specifies the interfaces between SALT and the SAAO-supplied SALTICAM camera in its three roles as **Verification Instrument (VI)**, **Acquisition Camera** and **Scientific Imager (ACSI)**. As far as interfacing is concerned, the Acquisition Camera and Scientific Imager modes are identical and these are referred to as ACSI mode. The interfaces are optical, mechanical, electrical, signals (both electrical and fibre optic), dry air, glycol, cryogen, software and maintenance.

2 Optical

This section specifies the optical interface between SALT and SALTICAM.

SALTICAM is arranged in two different optical configurations when in VI or ACSI mode.

In **VI mode** no optics are present with only the filter unit followed by the shutter and cryostat window in the beam. The autoguider is not present either. Light leaves the Atmospheric Dispersion Corrector, passes through the moving baffle and proceeds to the VI.

In **ACSI mode**, two SALTICAM lens barrels get added to the optical path with the front barrel now forming the optical interface to SALTICAM. The SALTICAM autoguider now gets installed between the rear barrel and the cryostat window. The SALT Project team are responsible for supplying a folding flat mirror to be placed just after the exit pupil to feed the ACSI. In addition, other optics should be insertable at this position. The optical element list is currently:

- **Blank:** this allows light to proceed to the corrected prime focus. If PFIS slit-viewing optics are used, the relay system will feed light to SALTICAM from the PFIS long slit plane.
- **Folding Flat:** this feeds all the light to SALTICAM in ACSI mode.
- **Pellicle:** this feeds a fraction of the light to SALTICAM for closed loop guiding.
- **Dichroic (if approved):** this feeds (probably) UV light to SALTICAM while visible and red light proceeds to another instrument.

3 Mechanical

This section specifies the mechanical interface between SALT and SALTICAM in its two roles.

In VI mode, SALTICAM gets attached to the PFIS station mount point; in ACSI mode, it is attached below the rho-stage. In ACSI mode the autoguider gets mounted between the rear lens barrel and the cryostat window forming an integral part of the camera. Refer to document 3320AE0001mechanical.doc for full details on the autoguider mounting.

3.1 Weight Budget

The weight budget of SALTICAM is given in Table 1.

Item	VI mode	ACSI mode
Mechanical - overall	**TBD1**	40kg **TBC1**
Array Controller	6.5kg	6.5kg
Power Supply (including 3m cable)	6kg	6kg
Vacuum Gauge controller	1.7kg	1.7kg
Ion Pump controller	1.8kg	1.8kg
Auxiliary Controller	**TBD3**	**TBD3**
Cabling, etc	**TBD4**	**TBD4**

Table 1: The weight budget of SALTICAM

Note: The weight budget for the Cryotiger hoses is not included in Table 1 since this is the responsibility of SALT.

3.2 Envelope

Figure 2 shows the mechanical envelope for SALTICAM in VI mode measuring 628 x 456 x 350mm. **TBC1**

Figure 3 shows the mechanical envelope for SALTICAM in ACSI mode measuring 520 x 500 x 280mm. The 520 dimension depends on whether the "in-line" or "transverse" concept for the cryostat is adopted (see 3370AE0001 cryostat.pdf). **TBC1**

Figure 4 shows the mechanical envelope of the SDSU II array controller, measuring 360 x 175 x 140 mm. If the controller is to be fitted with a heat exchanger and insulated (see section 5), this envelope will have to be increased by about 20 mm all round.

Figure 5 shows the mechanical envelope of the SDSU II power supply, measuring 250 x 200 x 110mm.

Figure 6 shows the mechanical envelope of the vacuum gauge controller, measuring 241 x 89 x 273mm.

Figure 7 shows the mechanical envelope of the ion pump controller, measuring 106.4 x 128.5 x 206.5 mm.

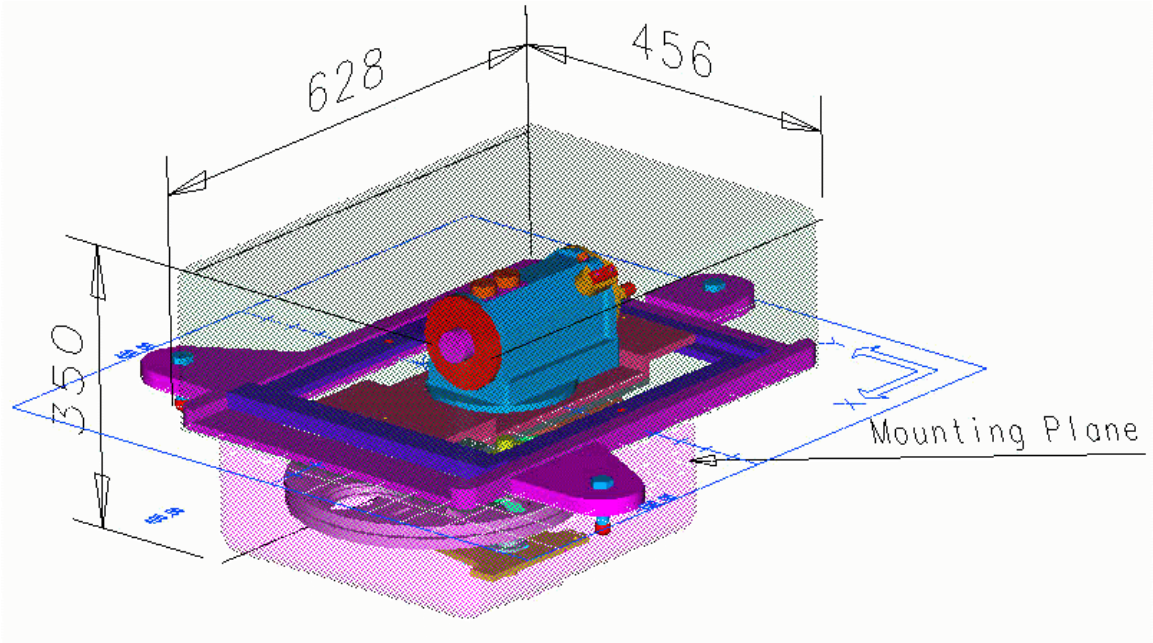


Fig. 2: The mechanical envelope and mounting plane of SALTICAM in VI mode

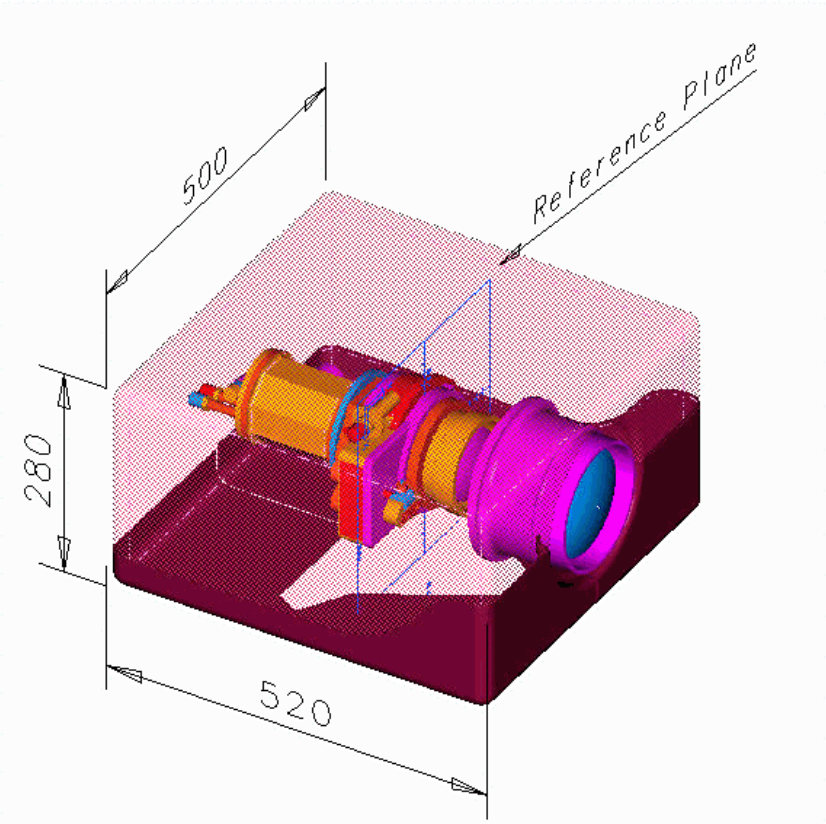


Fig. 3: The mechanical envelope of SALTICAM in ACSI mode

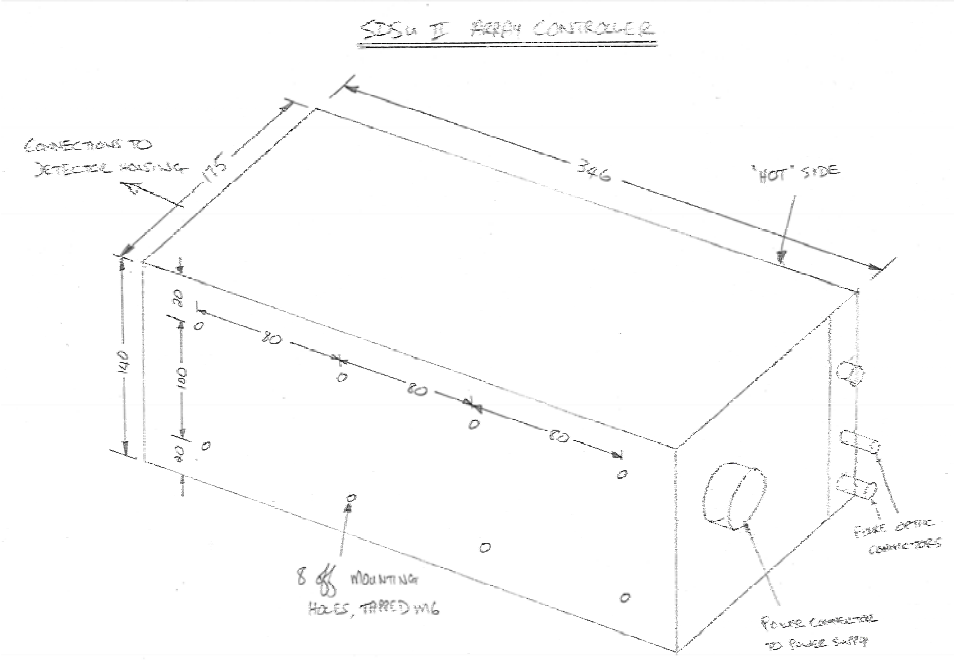


Fig. 4: The SDSU II Array Controller envelope and mounting point.

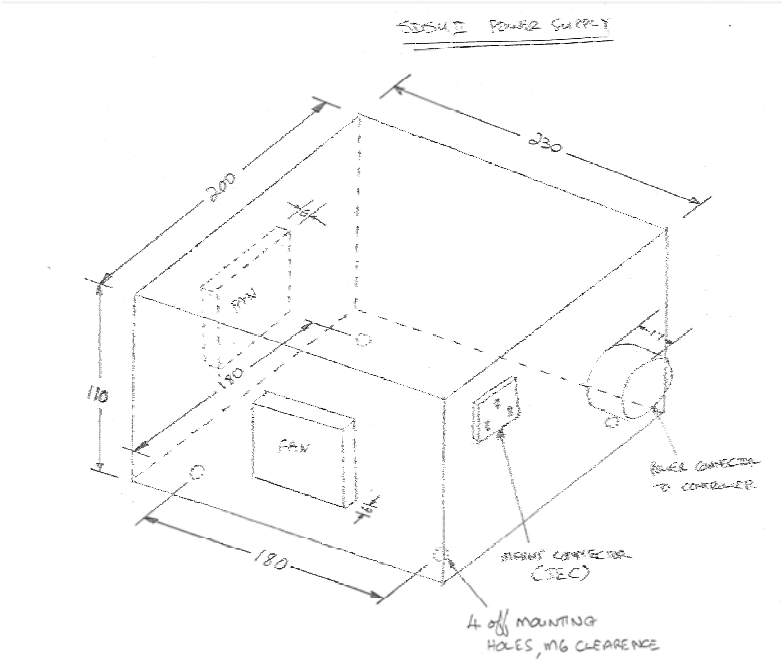


Fig. 5: The SDSU II Power Supply envelope and mounting point.

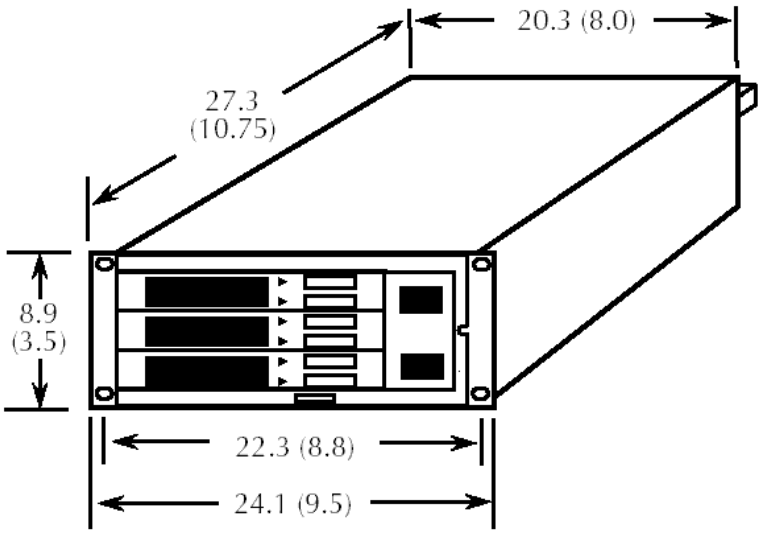


Fig. 6: The Granville-Phillips Vacuum Gauge Controller envelope and mounting point

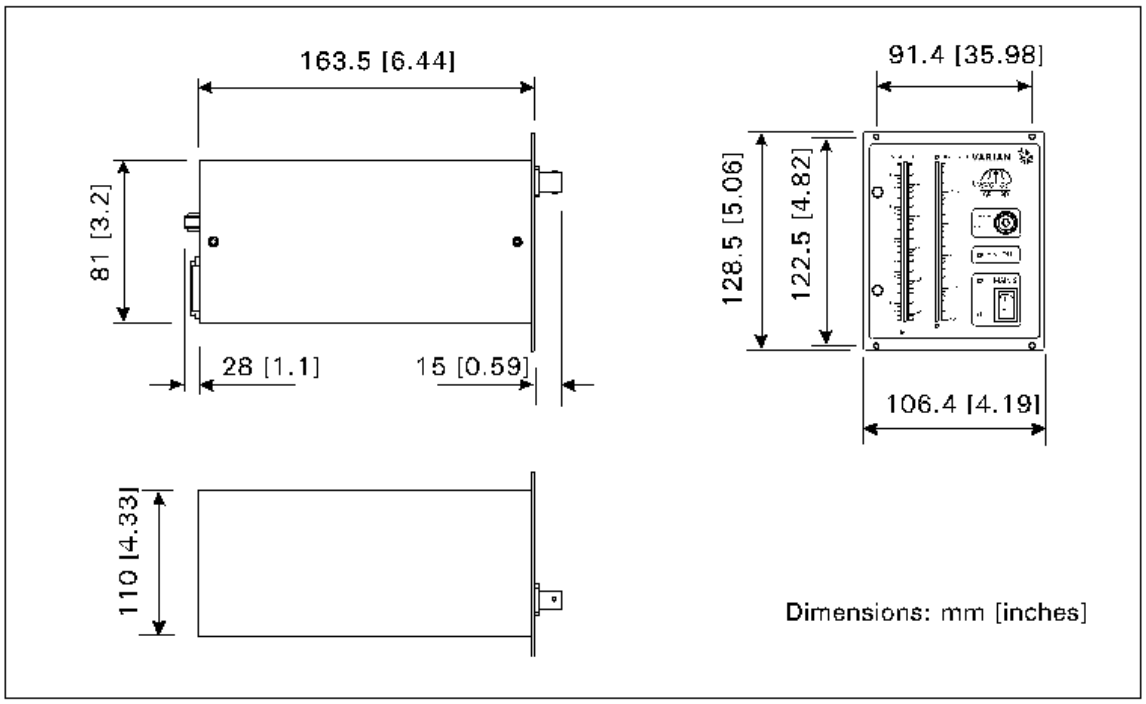


Fig. 7: The Varian MicroVac Ion Pump Controller envelope and mounting point

3.3 Centre of Gravity

The CG of SALTICAM in VI mode shall lie within a volume of 90 x 90 x 15 mm, measured 7mm above the mounting plane, centred around the optical axis z as depicted in Figure 8. This volume takes into consideration all 9 possible mounting positions of the instrument to cover the full focal plane during verification. **TBC1**

The CG of SALTICAM in ACSI mode is **TBD5**

The CG of the array controller shall lie within a volume of 15 x 15 x 15 mm centred on the locations as depicted in Figure 10.

The CG of the power supply shall lie within a volume of 10 x 10 x 10 mm centred on the locations as depicted in Figure 11.

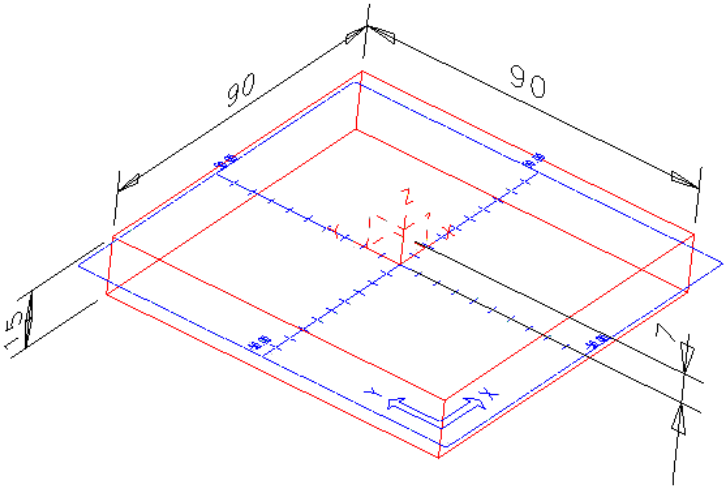


Fig 8: The center of gravity of SALTICAM in VI mode.

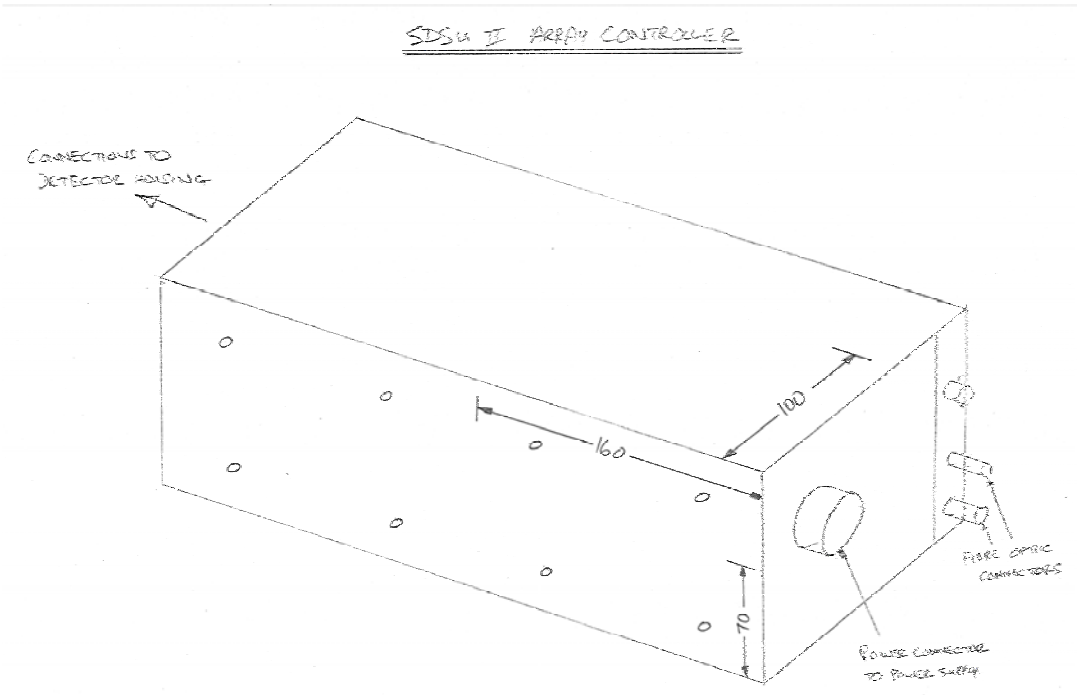


Fig. 10: The centre of gravity of the SDSU II array controller.

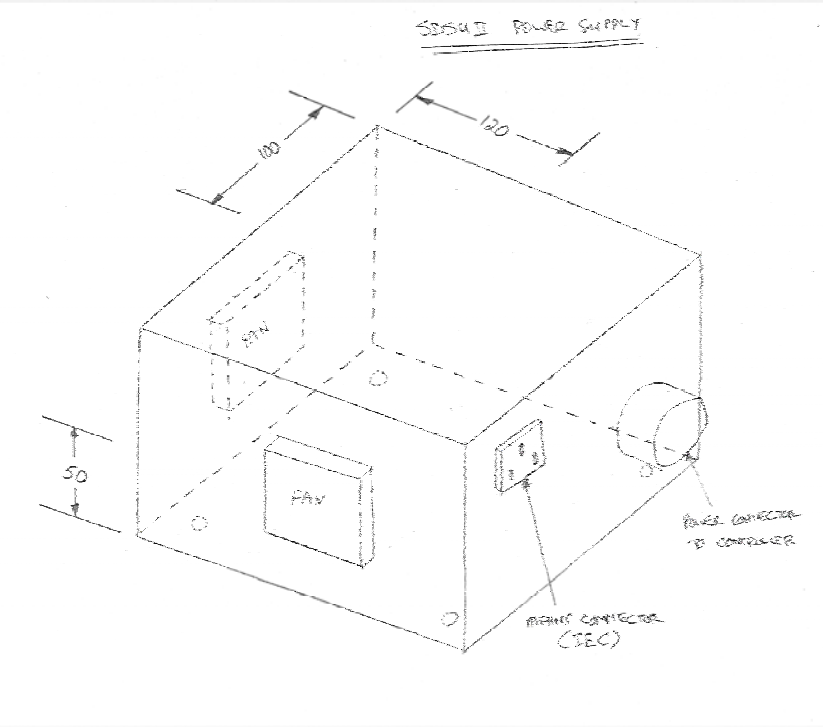


Fig.11: The centre of gravity of the SDSU II power supply.

3.4 Mount Points

Figure 2 shows the mount plane of SALTICAM in VI mode. **TBC1**

Figure 3 shows the mount plane of SALTICAM in ACSI mode. **TBC1**

Figure 4 shows the array controller mount point consisting of eight holes, tapped M6. Note that the end connecting to the detector housing has a connector length limit of 400 mm wire length.

Figure 5 shows the power supply mount point consisting of four M6 clearance holes.

Figure 6 shows the vacuum gauge controller mount point.

Figure 7 shows the ion pump controller mount point.

3.5 Handling Fixtures

The SALTICAM components shall accommodate cranes and hoists with suitably placed holes. Their location will depend on the detailed mechanical design, but should allow the components to be lifted in an attitude suitable for integration with SALT.

3.6 Shipping Container

Separate shipping containers shall be required for the different operational modes of SATICAM. Three shipping containers are foreseen, one for the verification instrument, one for the science/acquisition camera and one for the CCD cryostat only. The shipping containers shall provide for the safe transport of the components, and any tools and fixtures required to assemble, install, remove, and disassemble the appropriate components.

The shipping container will be suitable for road transportation in SAAO transport.

4 Electrical

This section specifies the electrical interface between SATICAM and SALT in its three roles.

4.1 Electrical Power

Electrical mains power is provided by the facility. All supplied power is UPS mains power with two levels of "purity". One level being "raw" UPS power (possibly shared by other systems on the telescope) for feeding the Cryotiger compressor, auxiliary controller, ion pump controller and vacuum pump controller. The mains power to the array controller is to be special "clean" UPS power, dedicated to feeding CCD systems only. The clean UPS mains power fed to the SDSU power supply will in turn provide power to the array controller and detector.

4.2 Electrical Connectors

SALTICAM shall use the same style electrical connectors as SALT. The type is **TBD2**.

5 Signals

This section specifies the signal connections between SALT and SALTICAM.

The array controller is connected to its host computer via a dual optical fibre bundle (labeled Twin Fibre in Figure 1). This bundle shall be routed through the telescope wrap-up without any interruption, i.e. the fibre optic is a point-to-point connection between the array controller on the one end and the host computer on the other end.

The fiber connector type is as supplied by ARC (Astronomical Research Cameras).

The array controller will also be connected to the CCD cryostat by a cable of no more than 400 mm in length.

The cryostat vacuum measurement reading is available as a serial RS-232/RS-485 digital number from the vacuum gauge controller. This signal is to be fed to the serial input of

the SATICAM PC via the telescope wrap-up using a standard computer serial interface cable. The connector type is **TBD6**

6 Dry Air

Two options for preventing the SALTICAM cryostat window misting over are being considered – a window heater or a dry air purge. If a dry air purge is decided upon, clean dry air will have to be supplied by the facility. The specification of this dry air feed is **TBD7**.

7 Cryogenic and Refrigeration

This section describes the cryogenic and refrigeration interfaces between SALT and SALTICAM in all its modes of operation.

SALTICAM requires both cryogenic cooling for the detector housing and refrigeration for heat disposal from the power supply, array controller, vacuum gauge controller, ion pump controller and auxiliary controller.

The cryotiger hose shall be routed from the Igloo, up through the telescope wrap-up to the cryostat-mounted cryotiger head. This hose shall be a combination of flexible stainless steel hose (as supplied by the cryotiger manufacturer) and solid copper tubing to enable disconnection for maintenance purposes. The location(s) of the connection points between hose types and the connector type is **TBD10**. The connector type at the two ends, i.e. at the cryotiger compressor and the cryotiger head will be as supplied by the cryotiger manufacturer.

Two possibilities of implementing the cooling of the power supply, array controller, vacuum gauge controller, ion pump controller and auxiliary controller are **TBD8** – either using a standard "SALT cooler box" as depicted in figure 1 or if the 400mm cable length constraint proves to be too troublesome, the array controller can be modified such that one or more of its external surface(s) (most probably the side marked "HOT SIDE" in Figure 4) to be a glycol heat exchanger and insulate the complete component.

8 Computers and Communications (TBD14)

This section specifies the computer and communications interface between SALTICAM and SALT.

The array controller will be controlled with LabView on a "Real Time" (RT) Linux PC with a PCI backplane (labelled SALTICAM PC in Figure 1). The LabView front end will communicate with a RT Linux Module which will control the array controller.

Communications between SALTICAM and SALT will be on Ethernet, under the control of LabView's network communications protocol.

SALTICAM in all its modes will provide (via standard LabView protocols) all relevant status information. The details are **TBD9**.

9 Software (TBD14)

This section specifies the software interface between SALTICAM and SALT in all its modes. See 3390AE0001 software.doc for full details. Below is an overview as regards to interfacing.

SALTICAM, in all its modes will be controlled by LabView running under Linux.

9.1 Subarrays

TO BE DISCUSSED, TAKING CONTROLLER HARDWARE IMPLICATIONS INTO ACCOUNT.

The subarrays can be of any size. They will be specified on the fly, and may be changed at any time between readouts.

Subarray processing includes determining the background, summing the counts above the background, and prebinning in either dimension.

9.2 Readout Modes

Three readout modes will be supported by SALTICAM namely Full Frame readout mode, Frame Transfer readout mode and “Slot” mode.

In full frame readout mode, the frame transfer mask will not be obscuring any light reaching the CCD, thus exposing the full CCD active area. This mode is suited for long exposures where exposure control is being done by an iris shutter.

In frame transfer mode, the frame transfer mask covers the “store” half of the CCD, obscuring it from light while the image integrates on the un-obscured “image” half of the CCD. At the end of the exposure, the image rapidly gets moved into the store area to be read out while the next image integrates in the image area. This mode is suited for short exposures while the shutter is kept open.

In slot mode, the CCD is obscured from light except for a narrow slot in the frame transfer mask, positioned over the image area just before the image/store split. After each slot exposure, only the slot width and penumbral region width gets clocked in under the obscured store area from where these slot images are read out once the store area is full. This mode is suited for very high speed photometry.

All readouts will be time-tagged to an accuracy of 1 milliseconds

9.3 Commands

SALTICAM will execute the following high level commands.

- Do a “prepare readout” (i.e. clear out the CCDs).
- Do a *n* seconds full frame exposure.
- Do a *n* seconds frame transfer exposure.
- Do a *n* seconds slot exposure.
- Do a *n* seconds dark exposure (i.e. without opening the shutter).
- Change pre-bin mode to *m* x *n* for subsequent frames, where $1 \le m \le 9$ and $1 \le n \le 9$.
- Subarray (window) multiple up to **TBD13**.
- Status/telemetry request.

9.4 Telemetry

The Detector LabView VI shall provide, via standard LabView methods, the following information.

- Array controller mode (e.g. Standby, Ready, Busy, Error, etc).
- CCD temperature.
- Cryotiger (cold plate) temperature.
- Internal temperature of array controller.
- CCD temperature-servo-heater power dissipation (indirect check on vacuum quality).
- Cryostat vacuum.
- Shutter closed/open status.
- Frame Transfer mask position.
- Frame mode (e.g. Full frame, Frame transfer, Slot mode, etc).
- Filter position.
- Focus position.
- Pre-binning mode.
- Integration time left.

10 Maintenance

SALTICAM’s CCD cryostat will require occasional vacuum pump downs at a frequency of around 6 months at which time the getter may need regeneration as well. **TBD11** The connector type will be a standard KF25 flanged vacuum connector.

Ideally, the vacuum pump down should be achieved without removal of the cryostat from SALTICAM. **TBD12** If not possible, the cryostat should be removed without disturbing SALTICAM. It should be noted that the shorter the vacuum hose between the vacuum pump and the cryostat, the better for achieving a good vacuum in a short time. Thus, to pump the cryostat in-situ, a portable vacuum pump would be required, connecting to the cryostat using a flexible vacuum hose, mounted as near as possible to SALTICAM.

11 List of TBCs and TBDs

TBC1 - These values can only be confirmed after the concept is finalised

TBD1 - Weight budget of SALTICAM in VI mode

TBD2 - SALTICAM electrical connector type

TBD3 - Weight budget for the auxiliary controller and power supply

TBD4 - Weight budget for the cabling, etc.

TBD5 - Centre of gravity of SALTICAM in ACSI mode

TBD6 - RS-232/RS-485 connector type

TBD7 - Specification of the dry air feed

TBD8 - Alternative cooling schemes for array controller and its power supply

TBD9 - Detector subsystem status information packet

TBD10- Location(s) and connector type in the different cryotiger hoses

TBD11- Removal of the getter during vacuum pump down

TBD12- Removal of the cryostat for vacuum pump down

TBD13- Subarray multiple

TBD14- All aspects of communications of commands, status and data between the SALTICAM PC and SALT