Rosetta lander Experiment Interface Document A
(REID-A)

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- " -		5	Aug. 1999	New	MS
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- " -		6.6	Aug. 1999	Revised, shifted to the end	Jbi
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- " -		8.1	Aug. 1999	Testmatrix inserted (from VPP)	GG
- " -		8.3	Aug. 1999	New and expanded	AO
- " -		9.3.7/fig.26-29	Aug. 1999	New figures from DLR server	Jbi
- " -		13, 14/fig. 32	Aug. 1999	Minor changes (Organisation, WBS, Organigramme, Schedule)	Jbi
- " -		15	Aug. 1999	New	OK
- " -		1,2,9.4	Aug. 1999	Corrections	UR
- " -		4	Aug. 1999	Corrections	TT
- " -		12	Aug. 1999	revised	JB
- " -		All	30. Aug. 99	Minor corrections	Jbi

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CONTENTS

1 GENERAL

1.1 Purpose of the Document

The Rosetta Lander Experiment Interface Documents (REID-A and -B) will be the formal agreement on engineering, ground and flight operations and programmatics between the Rosetta Lander Project and its Team Members.
Part A contains the Lander description, interface requirements and guidelines of a general nature to which the Lander Team Members supplying hardware should comply with.

It should aid and guide the Team Members throughout the design, manufacture and verification phase of the Project, but also will contain all relevant information for ground and flight operations.

It will list all major milestones throughout the program, especially those concerning design reviews, deliverables and integrated tests.

1.2 Overall Programme

The technical goal of the Rosetta Lander Project is to design within tight mass and funding constraints a vehicle rendering possible in the harsh environment on the surface of a cometary nucleus a wide range of ambitious in situ and remote-sensing investigations from the time of landing for several weeks, ideally up to the comet's passage through its perihelion.

The scientific objectives of the Rosetta Lander can be listed according to their priority as follows :

1. Determination of the composition of cometary surface matter: bulk elemental abundances, isotopic ratios, minerals, ices, carbonaceous compounds, organics, volatiles - also in dependence on time and insulation.
2. Investigation of the structure and physical properties of the cometary surface: topography, texture, roughness, regolith scales, mechanical, electrical, optical, and thermal properties, temperatures. Characterisation of the near surface plasma environment.
3. Investigation of the local depth structure (stratigraphy), and global internal structure.
4. Investigation of the comet/plasma interaction
5. Provision of ground truth data for Orbiter instruments.

1.3 Rosetta Lander Description

The Lander is designed as an autonomous system, fulfilling a long operational mission from the time of landing (at a solar distance of about 3 AU) up to about 2 AU. This phase will last about 6 months.
The Lander is described in a living document, the Rosetta Lander System Specification (Ref.: RO-LAN-SP-3101, Issue Basic, Rev.0, 29.06.1998), which is available on the MPAe server : http://roland.mpae.gwdg.de/pub (see chapter 15).

- The baseline configuration of the Rosetta Lander is shown in Figure 1-1 and Figure 1-2.
- The Lander structure consists of three basic assembly units, the Instrument Carrier, the Base Plate and Support Truss and the Solar Hood. See chapter 1.4.
- The complete Lander is splitted into a warm and a cold compartment.
- Mechanical Interfaces are defined in the Rosetta Lander Mechanical Interface Control Document, RO-LAN-IF-3502 (Draft, July 1999)

The Rosetta Lander will be supported by a landing gear, consisting of a foldable tripod and a central mechanism that dissipates most of the landing impact energy and allows rotation of the main structure with respect to the landing gear as well as height adjustment. The three legs will be unfolded shortly after separation from the Orbiter. They are connected to the main structure via a central extendible tube thus used as a damping mechanism. At impact, the energy will be dissipated via this tube by accelerating a motor. Rotability allows investigation of a large area underneath the Lander by the experiments, adds flexibility to the drilling system and allows stereoscopic panoramic imaging with a single stereo camera sensor. It also eases both, thermal and power control, and is part of the erection strategy in case of a tip-over at landing.

Immediately after impact an anchoring harpoon will be fired to secure firm fixation of the Lander to the ground.

The Lander´s descent will be initiated by the eject from the main S/C; a push-off mechanism with variable $\Delta \mathbf{v}$ capability (0.05 – 0.5 m/s) is foreseen. An active descent system (ADS) should in the nominal case provide vertical acceleration (in - z direction) during descent and immediately after touch down as hold down thrust. Attitude control during descent will be maintained by use of a flywheel. For reducing the descent time (max. 6 h) and to cope with the gas drag due to the comets activity a descent thruster (with a fixed Δv, 1m/s, thrust 30Ns) may be fired shortly after separation. At impact, most of the energy is dissipated in the landing gear. To avoid rebound due to the residual energy, propellant thruster is fired upwards. The thruster is mounted on top of the hood, above the center of gravity.

The Rosetta-Lander is equipped with a Sample Drill & Distribution (SD2) subsystem which is able to collect cometary surface samples at given depths and distribute them to the following instruments: ÇIVA-M (microscope (MS) & Infrared Spectrometer (IS), the ovens, serving COSAC and PTOLEMY. Comet sample from pre-determinated and/or known (measured) depth are collected and transported by SD2 to well defined locations:

- MS & IS viewing place
- ovens for high temperature (800°C) heating (for Ptolemy: 4 ovens; for COSAC: 16 ovens, each used once)
- ovens for medium temperature (180°C) heating (for COSAC: 6 ovens, reusable after cleaning).

The SD2 design concept includes:

- drill unit
- sampler unit
- volume checker

- carousel for sample distribution
- control electronics.

Telemetry and Telecommand data links to the Rosetta Orbiter, which acts as a relay for telecommunications to Earth, are provided by a redundant S-band telecommunications system. Patch antennas are foreseen for data transfer to and from the Orbiter. They will be mounted above the ”balcony”. A Lander / Orbiter telecommunications unit will be part of the ESS, mounted to the Orbiter.

A central data management system (CDMS) will control all Lander functions, deliver commands to the experiments and support and packaging of the scientific data as well as their transmission to the Orbiter. The CDMS will also make command and data storage available.

The Power System consists of solar cells and a battery system.
Solar cells on the hood with a projected area of approximately 0.4 m^2 generate >10 W electrical power averaged over the (illuminated) day, taking into consideration the degradation of the cells during cruise. About 4 W will be available at day-time to the scientific experiments at 3 AU on surface operations. Batteries, both primary- and secondary-, support Lander operation during descent, landing and at night time, cover peak-power requirements, and ensure the first 60h sequence (day and night), relying on primary batteries only. A central power management system provides power and data via a common standardised interface board to all subsystems and experiments.

The thermal subsystem is based on a two tent superinsulation concept to provide an internal or „warm“ compartment (-40 to +55 deg C operational). To minimise an additional electrical heating the internal compartment is warmed up via a so called Thermal Absorber.

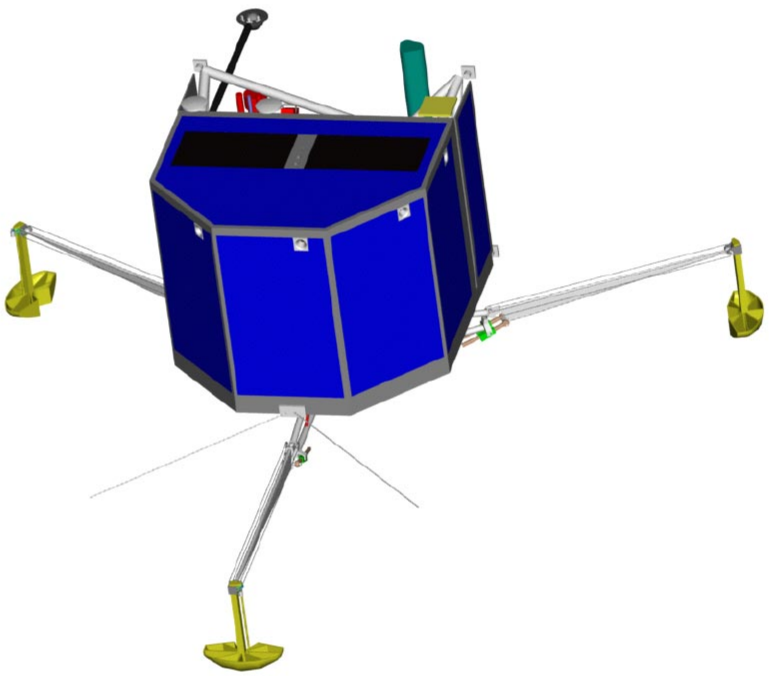


Figure 1-1 Rosetta Lander configuration (front view)

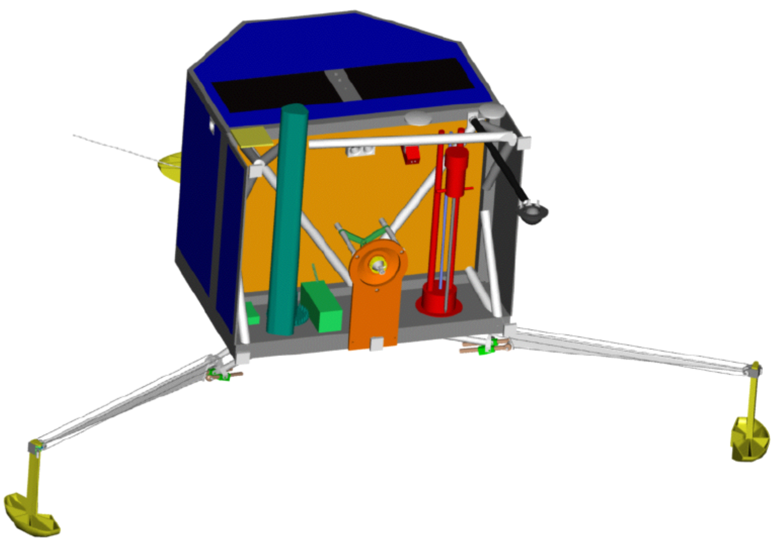


Figure 1-2 Rosetta Lander configuration ("balcony view").

Item	Obligatory Mass (kg)	Mass (kg) incl. var. margin
Payload	21.1	24.6
Structure	13.8	
Thermal Control System	4.7	
Power System (incl. solar array. batteries)	8.8	
E-box	0.4	
CDMS	1.7	
Harness (on Lander)	2.0	
Telecoms unit (Lander)	3.3	
Landing Gear	5.2	
Harpoon-Anchoring System	1.2	
ADS	3.2	
Flywheel	1.7	
Eject Mechanism (Lander)	0.5	
ESS (incl. TxRx-Orbiter)	4.2	
MSS (incl. eject mech.-Orbiter)	5.0	
Harness (Orbiter)	1.4	
Balancing mass	0.5	
Total	**78.7**	**87.5**

Table 1-1 Rosetta Lander System mass budget.

Payload Instrument	Obligatory Mass (kg)	Mass (kg) incl. var. margin
APXS	1.0	
MUPUS	1.8	
ÇIVA / ROLIS	3.45	
CONSERT	1.5	
COSAC	4.35	
PTOLEMY	3.3	
ROMAP	0.6	
SESAME	1.5	
SD2	3.6	
Total	**21.1**	**24.6**

Table 1-2 Rosetta Lander Payload mass budget

A variable mass margin, oriented at the status of S/S or Payload instrument definition is taken into account by the Project office in each case, summing up to the maximum value as defined in Table 1-1 and Table 1-2 above (Mass (kg) incl. var. Margin). Nevertheless, the given mass values without any margin are binding design handicaps. The (margin) delta only will be set free by the Project Manager within the project development, based on verified and well founded reasons. No demand on mass margin is acceptable - note : the given total mass incl. var. margin of 87.5 kg is still above ESA mass allocation for the Rosetta Lander !

1.4 Subsystem Overview

1.4.1 Structure

The ROSETTA Lander structure is the mechanical basis for all other subsystems and payload components and has common interfaces with all of them. It is mainly composed of carbonfiber sandwich plates or rods, because the given strength and stiffness criteria can only be satisfied with the available mass budget when the superior mass-specific strength and stiffness properties of carbonfiber material can be utilized.

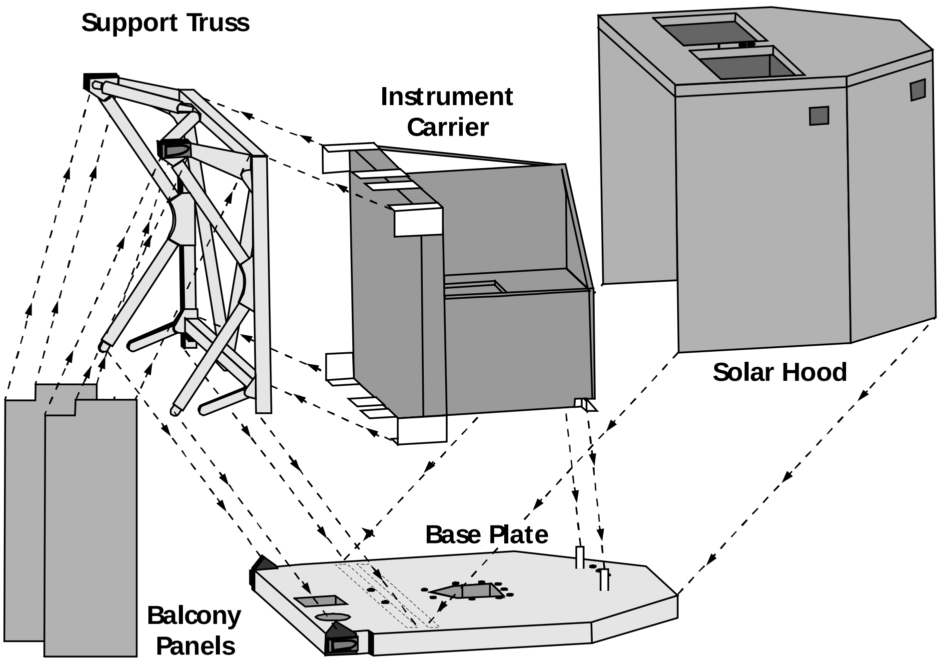


Figure 1-3 Basic configuration of the ROSETTA Lander structure

The structure consists of three basic assembly units, each of which is again composed of several primary and secondary components:

1. The Instrument Carrier is the central unit of the Lander structure. It consists of a rectangular Instrument Platform, two Auxiliary Plates standing perpendicular to this platform, a Front Plate and a Top Plate in between these two Auxiliary Plates, some stiffening struts, a stiffening triangle, 8 Kevlar webs, and a Kevlar angle.

All those subsystem and payload units which need thermal protection in the „warm compartment“ of the Lander are mounted on the Instrument Carrier which is entirely wrapped with MLI when the accomodation is accomplished. Once integrated, the only mechanical connections to the outer parts of the structure are the a.m 8 Kevlar webs, the Kevlar angle, and 2 Kevlar tubes which are inserted in the Base Plate.

2. Base Plate and Support Truss are individually manufactured but monolithically connected before delivery. Together they form the second assembly unit.

   The Base Plate carries the Landing Gear and, on its free part, the so-called „balcony“, the tools and instruments which must operate outside the warm compartment. It serves as operating platform for the whole Lander during cruise flight, eject, descent, and all operations on the comet.

   The Support Truss serves as mechanical basis during launch, when all forces between the Lander and the Orbiter are transferred through its four corners where the MSS Adapters, made of Titanium, are attached.

3. The Solar Hood is the third assembly unit. It serves as carrier structure for the Solar Cells, the Thermal Absorbers, and (ÇIVA-P) single cameras and as one Landing Gear launch lock. Simultaneously it is the protective casing for the warm compartment underneath.

   The Solar Hood consists of the Lid, the Side Walls, and two Balcony Panels which are fixed on the Support Truss. The Side Walls are monolithically connected with each other and, as a whole, mounted on the Base Plate and on the frame of the Support Truss. The Lid is mounted on the upper edge of Side Walls and Support Truss.

Assembly units and components of the Lander structure are described in the valid Specification of the Structure and Subsystems, RO-LST-SP-3601.

The general features of the structural components are the following :

- Sandwich Plates (Face Sheets and Cores) :

  The sandwich face sheets must be lightweight and as stiff as possible. Therefore, high-modulus carbonfiber fabric / epoxy laminates were selected. These laminates are orthotropic. The sandwich cores consist of aluminium honeycomb material. The honeycomb cells are perforated or slotted to allow for quick evacuation (venting) during launch.

- Carbonfiber Struts :

  The carbonfiber struts which are mainly used in the Support Truss obtain their excellent weight-specific strength and stiffness from the unidirectional carbonfibers in longitudinal direction. The thin glassfiber-braided hose which is circumferentially surrounding the carbonfiber layer is due to the manufacturing process, as well as the hard foam core in the interior.

- Kevlar Stand-Off Elements :

Two types of stand-off elements are used as thermal isolators, namely cylindrical tubes and shear webs which carry the normal forces and the shear forces between the fully accomodated Instrument Carrier and the outer structure, i.e. Support Truss and Base Plate. They are made of Kevlar since this material is a bad heat conductor.

- Surface Coating :

  All outer surfaces which are subject to solar and cosmic radiation are coated with a protective aluminium foil, as far as they are not covered with solar cells. Underneath the solar cells, the sandwich plate surface bears a non-conductive layer. In the interior of the Lander, the instrument-bearing surfaces of the Instrument Carrier are coated with aluminium for conductivity reasons.

- MSS Adapters :

  The mechanical interface between the Lander structure and the separation nuts on the Orbiter side (which belong to Subsystem MSS) are the titanium adapters which are attached to the four corners of Base Plate and Support Truss.

- Inserts and Payload Adapters :

  The inserts used for the P/L and S/S fixation on the structure and the P/L adapters used for the adhesively attached items are described in Section 2.5.

1.4.2 Power System

The power system is based on a solar generator covering most of the hood (the lid and the side-panels except the one facing the balcony), thus providing a projected area, depending on aspect angle, of about 0.4 m^2 of solar cells. At 3 AU, this generator will produce an untreated electric power of approximately 12 W when sunlit. About 4 W will be available for the scientific instruments. A rechargeable battery of 100 Wh will cover peak power requirements and enable reduced operations at "night". A primary battery will secure the descent and the first scientific sequence.

1.4.3 Command and Data Management System (CDMS)

The Lander CDMS serves as the central, intelligent, interface for commands and data transmission between the Lander receiver / transmitter and all Lander subsystems and instruments. It controls the subsystems on the basis of special software and telecommands and also realises the housekeeping system.

1.4.4 The Command and Data Link (CDL)

The CDL will, as a baseline, operate in S-band. A data rate of 16 kbit/sec for a minimum of 15 min/day is envisaged. Of course, the actual transmission profile is highly depending on Wirtanen´s physical and thus, Rosetta´s orbital parameters.

1.4.5 The Thermal System

The Rosetta Lander thermal system combines a cryostat-like thermal insulation of the payload compartment with storage of electrical as well as thermal energy to guarantee the survival temperature for electronics in the compartment.

1.4.6 The Landing System

The landing system is currently foreseen to follow a passive scheme. Thereby the Lander is ejected from the Orbiter by a release mechanism that allows to adjust the separation Δv between 0.05 and 0.5 m/s. The Lander will descend to the nucleus being accelerated by a descent thruster. The attitude is maintained my means of a fly-wheel. Upon touch-down, the thruster is fired to impede rebounds. Additionally an anchoring harpoon will be fired.

1.4.7 The Anchoring System

In order to permit mechanical interaction with the nucleus, as drilling, the Lander will be fixed to ground by means of an anchoring system. Pyrotechnical harpoons whose tethers can be tightened by means of winches will be implemented.

1.5 Payload Resources

Total payload mass	24.6 kg incl. margin (var.)
Total payload volume	
-inside compartment	440x776x532.6mm^3
-outer compartment	209.3x779x563.25xmm^3
Temperature range inside compartment	
-operational	-40 / +50° C
-nonoperational	-55 / +70° C
Temperature external	min. (design goal): LN2 temperature
Battery capacity	
-primary	ca. 70 Wh
-secondary	ca. 70 Wh
Voltages	+28 V,±12V,±5V (nominal) keep alive +5 V +18 V for ÇIVA +29 V / 23 V for CONSERT and for S/S
Average power for science at 3 AU	6 W TBC (in day time- incl. CDMS, TxRx, PCU, TCU) 0.2 W (at night)
Peak power available per instrument	20 W from LPC
Peak power for science at perihel	40 W from HPC
Command and data management system CDMS) capability	
-processor performance	0..2 MIPS mode dependant scalable (TBC)
-ROM	32 kBytes (TBC)
-RAM	64 kBytes (TBC)
-non volatile, reprogrammable memory	64 kBytes (TBC)
-mass memory	2 MBytes redundant; configurable as 4 MBytes non redundant. (TBC)
-serial I/O ports	as needed; max 24 (TBD)
Telemetry system capability during visibility	
-data rate Lander to Orbiter	16 kbit/s
-data rate Orbiter to Lander	16 kbit/s
-amount of data for first five days after landing	300 Mbit (TBC)
Launch loads	
-launch	specified by ESA (see EID-A)
-landing	2 g
Minimum resonance frequency	150 Hz (execept structure, MUPUS and SD2: 100 Hz)
Release speed	0.05 to 0.5 m/s
Landing speed (w/o deceleration)	0.1 to 2 m/s
Landing accuracy	± 100 m TBC
Anchoring	yes

1.6 REID-A Issue Schedule

The actual version of the REID-A reflects the ongoing iterative process of internal studies on Rosetta Lander System level, where the Rosetta Lander Technical team is working on a basic Lander design.

1.6.1 Applicable Documentation

Since the overall Rosetta Project regards the Rosetta Lander as a single interface to the Orbiter, the Lander Technical Project Team will be responsible to adhere to all guidelines listed in the Rosetta EID-A in a formal manner. Although the interfaces between the Lander Project and its Team Members can be treated somewhat less formal, the applicable documents are specified in the Lander Interface document Part B (Ref.: RO-EST-RS-3020/LIDB; Draft 2; Rev.: 0, Date : 30.Sept. 1997; Issue 1, Rev.0, 15 Jan 1999, Section 3.1).

2 MECHANICAL DESIGN REQUIREMENTS

2.1 Definition of Lander Reference System

The Unit Reference Point (URP) of the ROSETTA Lander is a right-hand coordinate system aligned such that the positive x-direction corresponds with the eject direction from the ROSETTA Orbiter and the positive z-direction is co-aligned with the z-axis of the Orbiter. The Lander Reference Point is located on the middle upper edge of the balcony part of the baseplate:

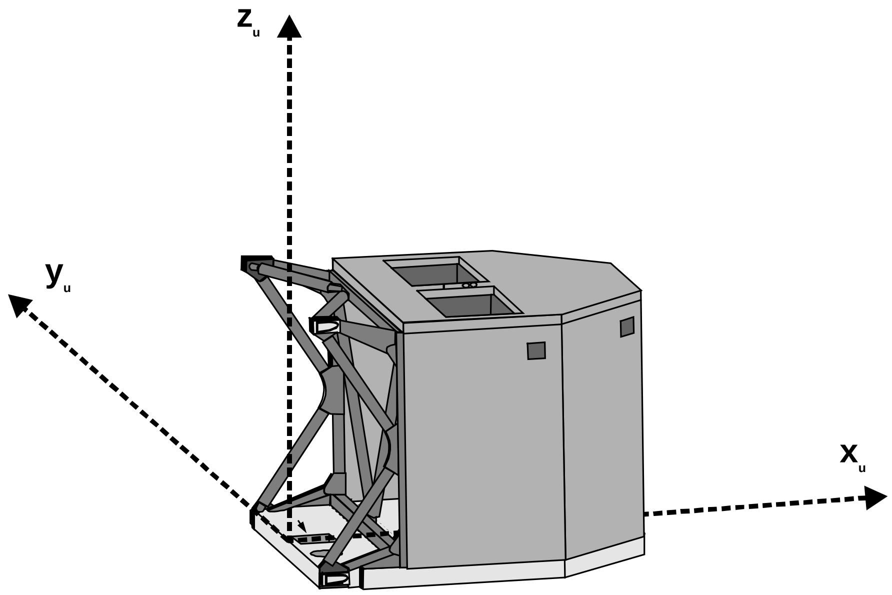


Figure 2-1 Unit reference frame (URF) of the ROSETTA Lander (balcony panels not shown)

2.2 Mechanical Interface Control Drawing

Detailed drawings highlighting designated spaces for the various instruments, showing their respective mechanical and connector interface plane(s), their available FOV's, URF, ref. hole access and aperture holes shall be supplied.
The interface between Subsystem/Payload and the Lander will be described in the Rosetta Lander Mechanical Interface Control Document, RO-LAN-IF-3502 (Draft, July 1999) and the LID-B document (RO-EST-RS-3020/LIDB).

For ease of integrating the Lander electronically during the construction phase, it is envisaged to use only CAD programs which have common import/export utilities (e.g. IGES; ProE (preferred)).

The experimenters shall provide the following documents:

- Mechanical Interface Drawing
- Structural Mathematical Model

- Structural Analyses
- Mechanism Analyses
- The alignment procedure
- Integration procedure if an individual handling is required

2.3 Experiment Structural Design

Refer also to the following documents:

- RO-EST-RS-3001/EID A, Vol. 2
- RO-EST-RS-3001/EID C, Part C

2.3.1 General Requirements

The experiment shall be designed to withstand the environments it will encounter during its lifetime without degradation to its performances and without detrimental influence on the lander or other experiments' performance. The mechanical loads produced by these environments shall include:

- fabrication and assembly loads (e.g. welding, interference fitting)
- handling and transportation loads
- test loads (including thermal stresses)
- Ariane 5 launch loads (vibration, thermal and depressurisation)
- operational loads (including thermal, attitude and orbit control induced loads)

The design of the experiment handling and transportation devices shall be such as to produce loads far lower than the predicted flight loads. Manufacturing and assembly induced loads shall also be minimised or properly relieved.

NOTE: The P/L and S/S mounted on the Lander will undergo various test cycles: the unit tests, the lander level tests, and the orbiter level tests. The test induced stresses are usually the most important factor limiting the life of structural items, particularly fracture critical items. Therefore if, for instance, a structure used for qualification is proposed to be reused as a flight spare, care should be exercised in determining well in advance that this is possible from a structural point of view. The design should therefore also consider the case of replacement of these critical parts. Permission to reuse qualification units as flight spare shall be requested from the Lander System Team.

2.3.2 Environment

Launch:

The launch loads are the most critical for the mechanical performance. The load levels in sine, random, acoustic and shock (flight environment) that the units mounted on the ROSETTA Lander will see are defined in Sec. 8. The levels given in Sec. 8.3.4 for quasi-static, sine and random vibration are based on the Lander STM test. The shock levels given are taken from the EID-A.

For the mechanical design of the units the qualification levels multiplied by the appropriate safety factors shall be used.

Orbit:

The units shall be checked for the in-orbit environment.

The accelerations produced during post-launch mission phases are defined in the EID-A as spherical envelope with respect to the Orbiter S/C Centre of Mass. They are set to 0.1 m/sec^2 and 0.05 rad / sec^2 , for linear and rotational acceleration, respectively.

2.3.3 Strength Requirements

Design Load

Design Loads are defined as those loads that the experiment may be subjected to during its life time with a certain probability level. Design loads are defined as limit load x design factor.

For the design of the S/S or P/L the design load shall be

- applied at the unit C.o.M.,
- acting along any direction (spherical)

For S/S and P/L listed in Sec. 8 the quasi-static load shall be used as design load. For all other units the design load is specified in Fig. 2-2.

Design Load - factored by safety factor - shall be used for design of bolts, feet and adjacent structure.

It shall be used for static sizing of the structure but the actual unit internal dynamic behaviour is not taken into account.

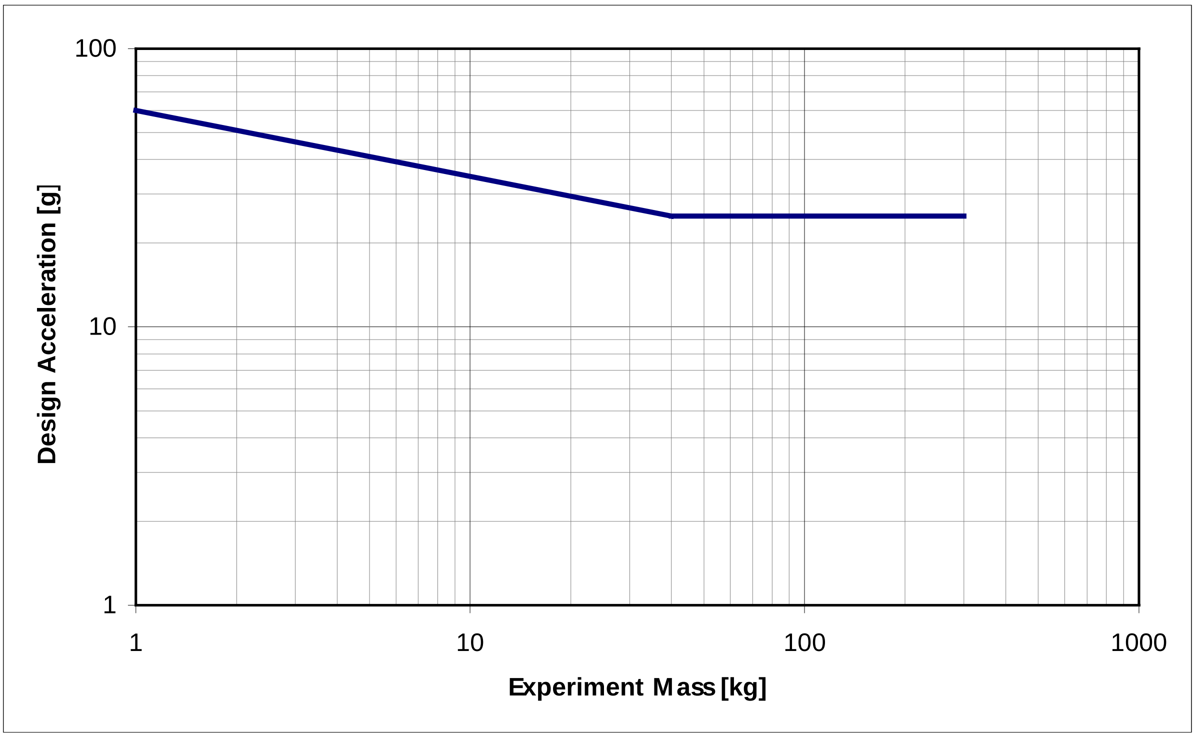


Figure 2-2 Design Loads

Dynamic Load

Sine , random, acoustic vibration and shock design load (e.g. qualification) - factored by safety factor - shall be used for analysing the dynamic stress internally induced in the structure. The load levels for the lander S/S and P/L are specified in Sec. 8.

Safety Factor

The safety factors shall account for inaccuracies in predicted allowable and applied stresses due to:

- Analysis uncertainties
- Manufacturing tolerances
- Scatter in material properties
- Setting at interface.

The following safety factors shall be used (from EID-A):

Item	Yield SF	Ultimate SF	Buckling SF
Conventional Materials Metallic	1.25	1.4	1.4
Conventional Material non Metallic	1.25	1.4	1.4
Unconventional Materials	1.7	1.85	1.85
Inserts and joints	1.7	1.85	NA

Table 2-1 Safety Factor

Item	With specific test, (Qualification or development)	Without specific test
Bonding, Structural inserts (axial loading)	1.1	2.0
Honeycomb in tension	1.65	forbidden
All materials if ultimate/yield < 1.2	1.0	1.7

Table 2-2 Additional Safety Factor

Success Criteria

Design loads (or the stresses they produce) shall be compared with minimum allowable loads (stresses) of materials and/or structural items to verify that:

$$\frac{\text{allowable load / stress (yield or ultimate)}}{\text{Design load x Safety Factor x Additional Safety Factor}} > 1$$

With a slightly different terminology, the verification shall therefore show that the margin of safety (MoS), defined as

$$\frac{\text{allowable load /stress (yield or ultimate)}}{\text{Design load x Safety Factor x Additional Safety Factor}} - 1 > 0$$

The allowable load/stress correspond to "A-values" as defined in MIL-HDBK-5 or equivalent documents.

Note: Pressure vessels and pressurised components are not covered by these definitions. The safety factors required vary with materials, type of tests performed, size etc. and will be defined on a case by case basis.

2.3.4 Stiffness Requirements

All experiment units shall show a first global resonance frequency higher than 150 Hz when bolted at their flight interfaces to a rigid fixture in stowed configuration. (Exception: structure, MUPUS and SD2, 100 Hz).
All experiment units with mechanisms locked during launch shall show a first global frequency higher than 2 Hz (5 Hz recommended) in unlocked configuration.
A design margin of 20 Hz, regarding the eigen-frequency in launch configuration shall be considered at analytical level to take into account scattering in the material characteristics and modellisation idealisation.
Resonances of internal items (PCB's, discrete large components) should also be high enough to avoid coupling with inputs from the launcher/spacecraft (ref to sine environment), which as a consequence of high amplification factors might compromise their functional capabilities.
Attention is drawn to the peak frequency ranges of random acoustic inputs where inputs to internal components might reach high values.

2.3.5 Mechanism Design

Refer to the relevant section in the EID-A.

2.4 Experiment Mass Properties

The mass allocated to the experiment should include the total hardware intended for flight, i.e. all mechanical, electrical and electronic parts, dedicated structural supports, electrical or thermal shielding other than already provided by the Lander structure. The mass of the common electronics box will be accounted to the different experiments according to the number of cards they require, plus a fixed mass for the common I/F board.

It will be the Team Members responsibility to stay within his allocated mass budget and margin. Due to the tight total available payload mass for scientific instruments, it deems impossible to take late mass increases into account.

The Center of Gravity (CoG) of each free standing unit should be defined w.r.t. its reference hole. The difference between the delivered box CoG to the computed one should not be greater than 3mm in all 3 axes.

Moments of Inertia should be computed for each free standing unit in the Lander reference frame with the CoG as its origin. The difference between the delivered box and the computed values should not be greater than 15%.

2.5 Experiment Mounting Attachments

2.5.1 Inserts

Payload and subsystem units are attached to the sandwich plates by means of inserts and screws. The selected lightweight insert design was chosen for mass reasons. It is based on a spreadable carbonfiber tube which circumferentially surrounds the borehole and fits exactly between the two sandwich face sheets. The rigid mechanical connection between this tube and the honeycomb material is achieved by an adhesive film.

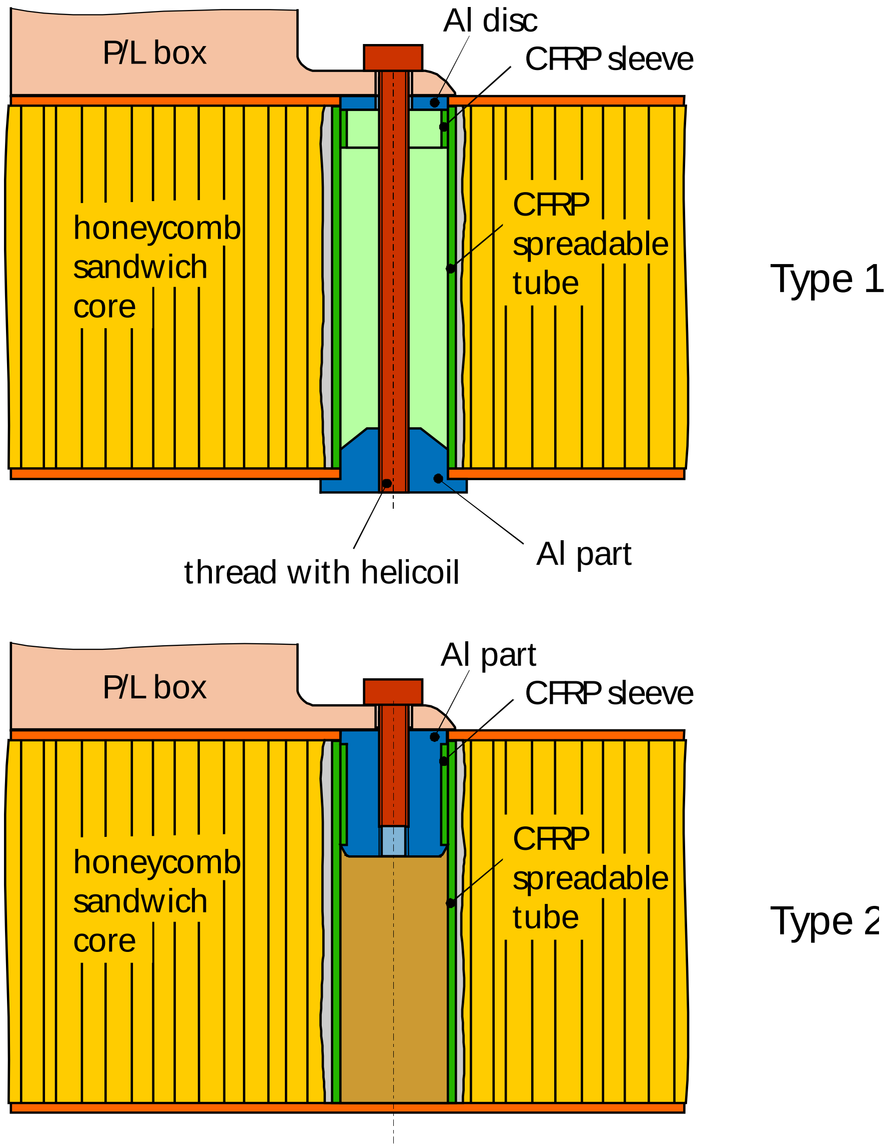


Figure 2-3 Principle design of insert types 1 and 2 (example with flat caps)

As shown in Fig. 2-3, two basic types of aluminium insert caps are being used :

- Type 1 is foreseen for some „heavy“ units where throughgoing bolts are needed to distribute the forces. The cap bearing the screw thread is on the opposite side.
- Type 2 allows for unilateral fixation and is used for most of the instruments

Both for type 1 and type 2, the insert caps are needed in different geometrical versions :

- The normal cap has a circular spot face of 14 mm diameter which protrudes by 1.5 mm TBC out of the sandwich surface so that all spot faces on the same panel can be grinded to achieve maximum parallelism among them.

- The flat cap (as shown in Fig. 2-3) is used for the inserts on the „balcony“, where units such as the SD2 ground plate or the APXS conus require an in-plane fixation directly on the surface. This affects also the ROMAP launch lock, the MSS Eject, ÇIVA-M, and the stand-off elements for ROLIS.

- The short cap is used on the Front Plate and the Top Plate of the Instrument Carrier, which are only 6 mm thick, for the fixation of the Flywheel and the CONSERT box.

The standard threads used for the mechanical interfaces on the Lander are M4 and M5, while M3 and M6 are only used for some special cases. Freerunning bronze helicoils (which are compatible with titanium screws for the FM) are inserted into the threads. Their ratio of length / diameter is 2.

Insert thread	M3	M4	M5	M6
Torque moment [Nm]	0.8	2.4	5.4	9.0
Torque tolerance [Nm]	± 0.08	± 0.24	± 0.4	± 0.8
Thread length [mm]	6	8	10	12

Table 2-3 Fixation of P/L and S/S units by means of titanium bolts (applies to FM)

In the (most usual) case of type 2 inserts, the thread length is identical with the required length of the screw underneath the unit´s foot.
For more details concerning the insert design, see the Subsystem Specification „Structure“ (RO-LST-SP-3601).

Each free-standing unit shall be fastened to the corresponding panel with a minimum of 3 bolts. For rectangular shaped boxes a minimum of 4 attachment points near the corners of the boxes is strongly recommended. The footprint pattern is to be agreed with the ROSETTA Lander System Team. The attachment points shall be designed to guarantee the connection of the boxes in a fail-safe manner during launch and throughout the service life. Loads and

safety factors for the design of the attachment points are defined in Section 2.3. The allowable insert forces for the lander provided inserts are currently under review. Until their publication the allowable insert forces defined in the EID-A Vol. 2.2 apply.
Insert forces and MoS for the P/L and S/S units calculated from the coupled ROSETTA Lander finite element analysis are provided in the Structural Analysis Report (RO-LST-AN-3504). These forces shall be used as a cross-check for the design of the attachment points.

Each footprint requires one reference hole for orientation and alignment purpose. Attachment pads shall have a minimum contact area of 3 cm^2 with the rest of the unit raised by 1 mm. The overall flatness of the foot pattern shall stay within 0.1 mm.

2.5.2 Adapters and Joints

A number of mechanical interfaces between P/L or S/S units and the Lander structure are not based on inserts, but on adapters and joints, mainly made of carbonfiber laminates, which are adhesively connected to the structure and shall be provided by the structure team:

- The upper part (+z) of ROMAP is attached to a carbonfiber laminate plate with 3 nuts / bolts. This plate is mounted in the upper right (+z / -y) corner of the carrier frame of the Support Truss.
- The upper part (+z) of MUPUS is connected with the long V-strut of the Support Truss by a carbonfiber clamp (this clamp only is not provided by the structure team but by MUPUS).
- MUPUS TM is directly attached to the long V-strut of the Support Truss by a clamp.
- The ÇIVA-P stereo camera is attached to a rectangular carbonfiber plate fixed horizontally below the long V-strut of the Support Truss.
- The upper part (+z) of the drill toolbox (SD2) is attached to both upper V-struts of the Support Truss by means of two connecting carbonfiber struts and clamps.
- DIM is attached to a carbonfiber laminate pedestal with a horizontal rectangular mounting area.
- The TxRx antenna ground plate is held in its horizontal position by several carbonfiber stand-off-struts which are, at their bottom end, connected with 4 fixation angles on the Support Truss and with the ÇIVA-P-Stereo adapter plate.
- The two CONSERT antenna adapters are adhesively connected to the edge faces of the Base Plate underneath Wall 2 and 4 of the Solar Hood.
- The interfaces between the upper Landing Gear launch locks (i.e. the fixations of the 3 feet) , and the structure (i.e. Solar Hood and Support Truss) are TBD.

Interface details wrt. these adapters and joints must be agreed, in each individual case, between the respective PI, the ROSETTA Lander System Team, and the Structure Team.

2.6 Experiment Alignment

Instruments which may need accurate alignment to one or more of the Lander's reference axes or which need to be co-aligned to other experiments should have forwarded their requirements for co-ordination to the Lander Technical Team before the start of phase C/D.

2.7 Experiment Aperture Covers

Removable covers for dust or handling protection should be clearly identified as 'non-flight item' (red-tag or red anodising of cover preferred).

Deployable covers (flight items) which need activation by Telecommand need to be designed in close agreement with the Lander Technical Team (e.g. since each opening in Lander's delicate thermal environment may be vital to its survival on the comets surface, it will be required to call the default position of the cover ”closed”-contrary to past experiences).

2.8 Experiment Electronics Boxes / Common electronics Box

Experiment electronics boards should be (but do not have to be) mounted in the common e-box (Figure 2-4). This should be reflected in the experiments mass breakdown with a 80 g ”entrance fee” and additional 28 g per cm used within the box.

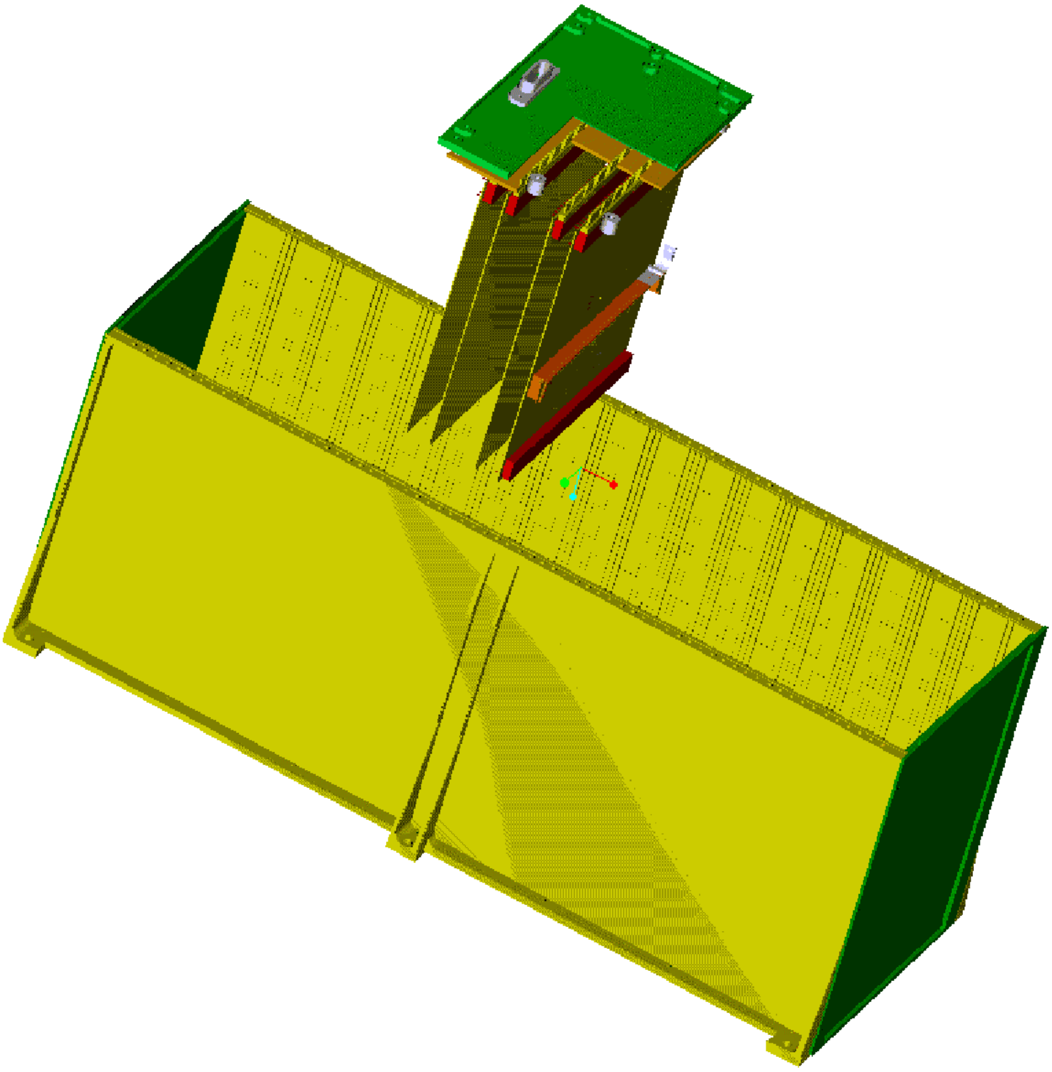


Figure 2-4 **Common Electronic Box. For more detail see chapter 5.**

3 POWER INTERFACE REQUIREMENTS

3.1 Lander power supply concept

3.1.1 General description

The Power Sub-system handles the energy sources of the Lander (i.e. Orbiter, solar generators, batteries) and provides (see Fig.3-6):

- The required electrical power from the non regulated primary bus thru switches and current limiters to sub-systems and experiments
- The redundant, current limited, stabilized secondary bus lines and switches to power the experiments/sub-systems via soft switch-on circuits
- The distribution of the low power keep alive voltage line to the experiments
- Special, separated voltages/current for sub-systems (CDMS, TCU, Harpoon-pyros) thru switches and current limiters

3.1.2 Available energy/power

Primary battery capacity: 700 Wh @ 15W discharge rate
Secondary battery (accumulator) capacity: 70 Wh

Power at 3 AU (from solar generator)

Average raw power at day-time	~ 10W
Average power to instruments	~ 4W
Peak power to experiments	20W (40W if HPC is active)
Average power to experiments at night	~ 0,2W
Available average power during the „first measuring sequence“	~ 15 W including power from prim. batt.

Power at 2 AU (from solar generator):

The available raw power at day-time is approximately 2 times that available at 3 AU. However, operations may be limited due to thermal reasons.

3.1.3 Lander primary bus description

The primary bus of the Lander is non regulated bus. This bus, depending on the topical operational phase, will be supplied from different sources of energy (see Fig. 3-6) and sometimes more sources will power it simultenously. The following table (Table 3-1) gives the expected bus voltages

	Cruise	Descent	First Measuring Sequence	Extended Mission			
				Day time		Night	
Source of energy	Orbiter Bus (+ Primary Battery)	Primary B. (+ Accum. + SG)	Primary B. (+ Solar Generator)	Solar Generator + Accu.	Solar Generator (no Accu.)	Accu-mulator	no Accu-mulator
Primary bus voltage	~27 V	28…27 V	30…27 V	29…23 V	30 V	29...23 V	0V

Table 3-1 Lander primary bus voltage limits

3.1.4 Power distribution

The Lander power distribution is based on a protected (i.e the converters/users are connected to it thru redundant switches and current limiters), continuously monitored primary bus. This bus powers the main converters (LPC, HPC) ⁻which separately generate five-five (plus one) different, −voltages rails to supply the experiments/sub-systems. The ⁻EPC converters ⁻supply the TCU −and provide−power for the rail of relays. −Two fully independent hot redundant converters (PS-CDMS) feed the CDMS while the similarly hot redundant AUX-PS converters supply the power control unit (PCU) the keep alive line (5VKAL) and the main timers (RTC) of the CDMS. The Pyro converters deliver the power to fire the harpoons‘ gas generators.

Lander controlled heater power shall be distributed via redundant switches and the current flow is continuously monitored.

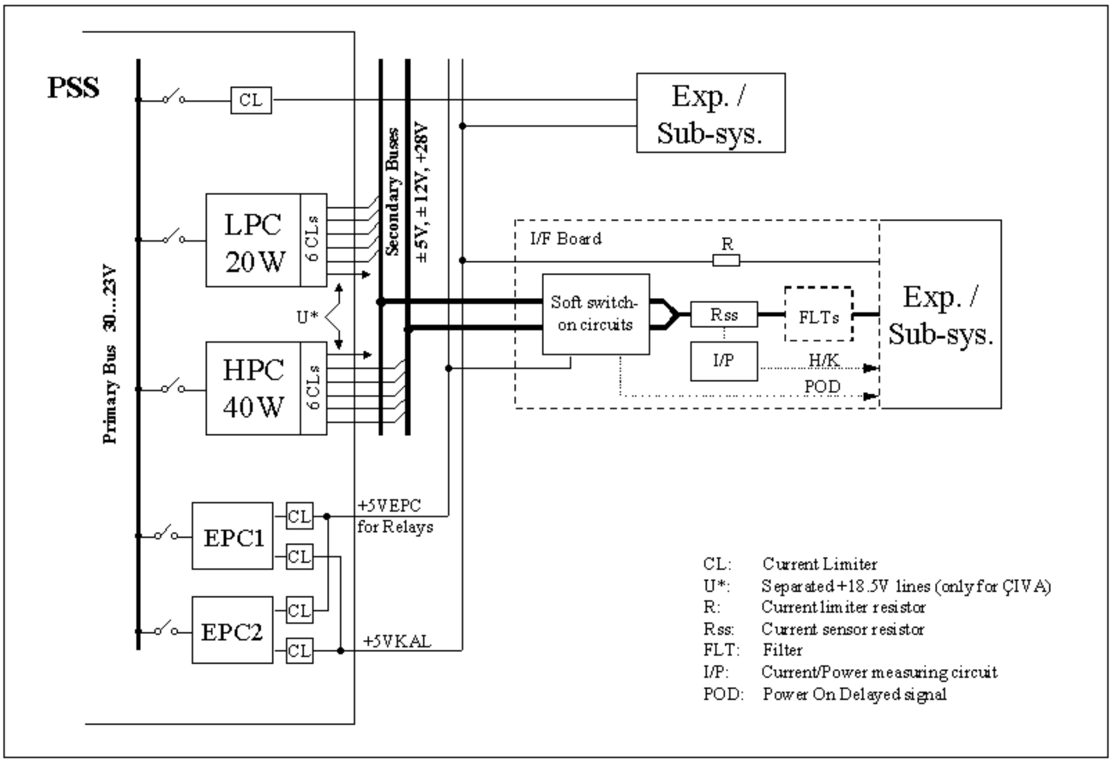


Figure 3-1 Power distribution to the experiments/sub-systems

3.1.5 Description of Lander converters

The Lander‘s main converters (LPC, HPC) generate five-five (plus one for ÇIVA) stabilised, current limited voltage-rails to supply the experiments/sub-systems. The input current and the output voltages of these converters are monitored (HK). The users get power from the rails via „soft switch-on“ circuits in order to minimise the troubles caused by in-rush currents.
The redundant „essential converters“ (EPC1, 2) produce regulated, current limited voltages for the TCU, for the rail that feeds the relays on the I/F boards furthermore ensures the charging current for the secondary batteries in the preseparation phase. The converter‘s input current and output voltages plus the charge current is monitored (HK).
The hot redundant PS-CDMS 1,2 converters feed the CDMS solely reducing the interference from other unit to the minimum. The input current and the output voltages are the HK data.
The redundant Pyro converters deliver the required high power for pyro ignition. Because of the short operational time only the input current is monitored (HK)
The low power, high efficiency auxiliary converters (AUX PS 1, 2) produce non interrupted voltage lines to feed the PCU, the keep alive line and the CDMS main timers.

The quality of these lines (see Table 3-2) will be maintained during the mission lifetime and under nominal load and temperature conditions.

In case of overloading of the main converter is in work (e.g. failure in one experiment actually switched on or too much loads simultaneous in operation) the PCU/CDMS switches off the converter, instantly disconnects all active experiments from the secondary bus and switch them back one after the other to fix the reason of the failure.

Considering that the keep alive line is powerd from the hot redundant AUX PS 1,2 converters it will disappear only in case of no primary bus voltage (e.g. lack of energy account of accumulator failure) at night.

3.2 Power supply interfaces (converters and primary bus)

The experiments/sub-systems shall be designed to operate with nominal performance within the following steady state nominal voltage ranges (the voltages are measured on the voltage rails of the EBox mother board in front of the I/F boards):

Interface	Nominal range	Minimum voltage	Maximum voltage
Primary bus	30 – 21V	19V	30,4V
Main converters (LPC,HPC)	+5.2V, -5.0V, ±12.0V, +28.0V +2/-3% (+18.5V; +10/-3%)	U_{nom}-20%	U_{nom}+10%
Keep alive line (5VKAL)	5.0V; ±5% @ I_L=0mA	4.0V	6.0V
Pyro converter	2.5A (U_{out}=2…8V); ±5%		
Essential conv. (EPC)	+5.0V; ±5% +32V; ±10%	U_{nom}-20%	U_{nom}+10%
CDMS conv. (PS-CDMS)	+5.6V; +2/-3 +15V; ±10%	U_{nom}-20%	U_{nom}+10%
Auxiliary conv. (AUX PS)	+5.0V; +2/-3% (see 5VKAL)	0V	U_{nom}+10%

Table 3-2 Operating voltage limits

All users shall be designed to safely survive any constant or fluctuating voltages in the full range of minimum to maximum voltages defined in Table 3-2.

The users have to survive the drop-out of any voltage line of the main converters for 1s and tolerate a complete power down in any phase of activity. In addition the users have to survive an unbalanced powering (i.e. the experiment gets only +5/+12V or only +28V or only -5/-12V) without parameter degradation for indefinit time (it can happen if a relay, that in general switches two voltage lines simultaneously in the soft switch-on circuit fails to switch off)

The users (fed from the main converters) shall also survive an instantaneous short circuit on any of the five voltage lines.

3.2.1 Redundancy

All experiment can be powerd from the LPC or the HPC main converters, in special case from both converters simultaneously, through the two uniform soft switch-on circuits are mounted on the I/F boards (see Fig. 3-3).

The primary bus users get the power thru redundant switches and redundant current limiters:

- In case of redundant user two serial connected, independently controlled switches and limiters (LSW2) are provided (see Fig 3-2.),
- In case of non redundant user (tipically the experiments) two serial and two parallel coupled switches and limiters provided to the user (2LSW2)

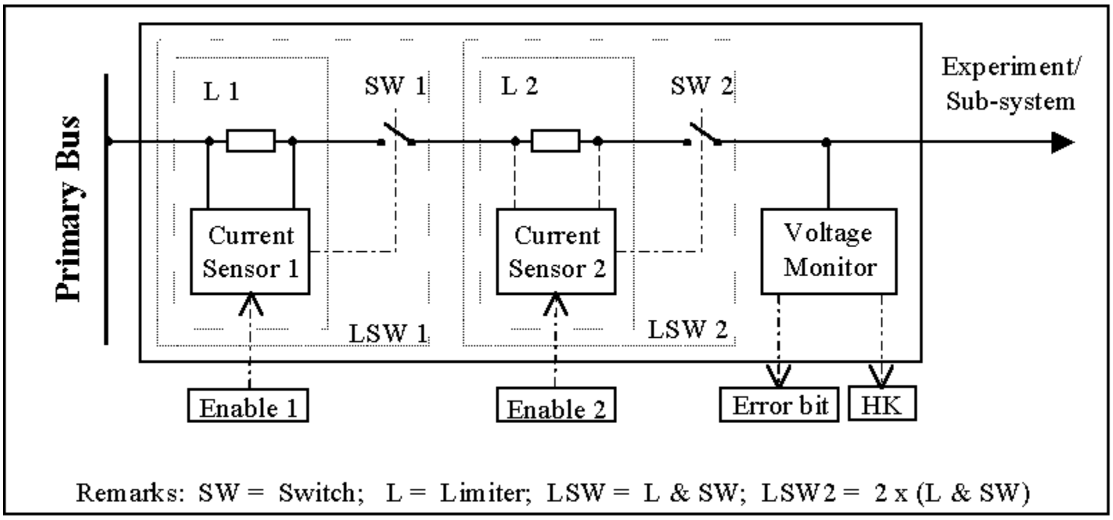


Figure 3-2 Primary Bus interface (LSW2)

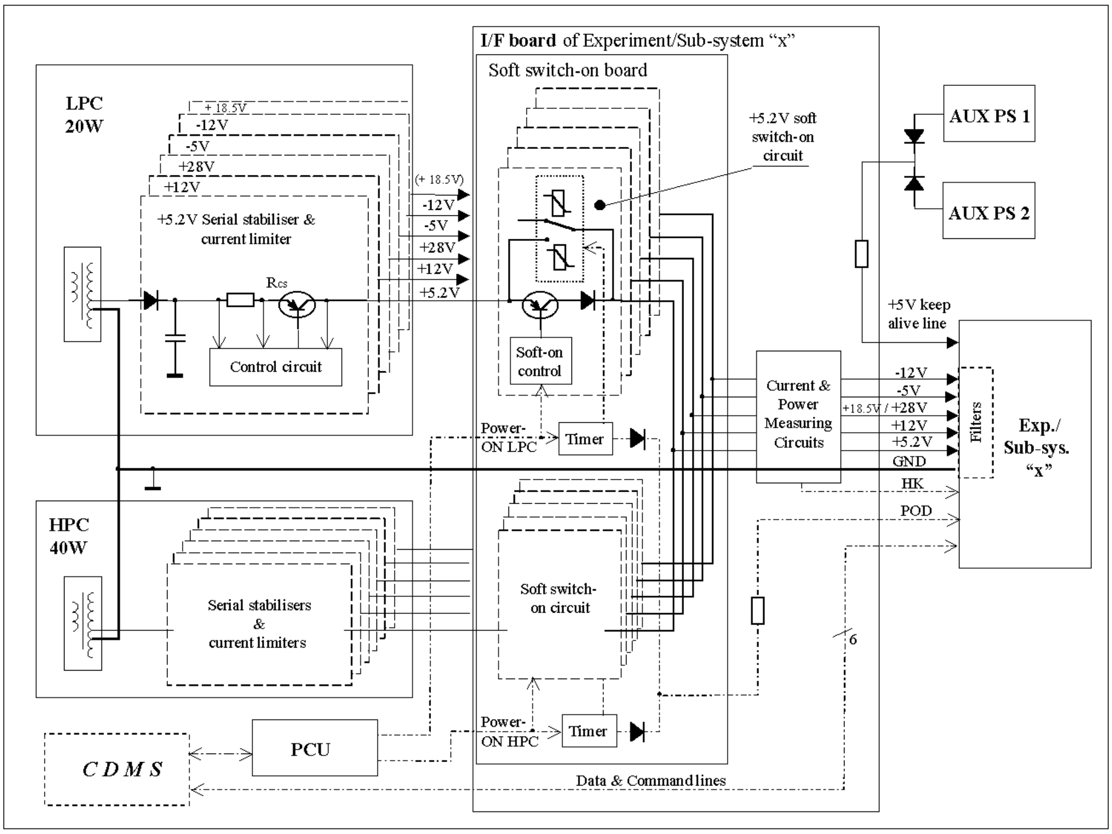


Figure 3-3 Experiment/sub-system redundant power interface

3.2.2 Current limiters

The current limiters in the main converters limit the outgoing current in the different voltage lines in the following way: the maximal available power on one voltage line is 60% ‑of the power that the converter can deliver (e.g. 12W ‑W in case of the LPC that has a nominal output power of 20W). In case of overloading of any line longer than 10 ms the PCU switches off the converter.

The current limiters characteristics ‑link up the primary bus and the users will be as specified in the following data sheet (Table 3-3)

Current Limiter Switch	
Maximum Nominal Output Current	The Current Limiter should be matched to the load. It means, that the Limiter maximum nominal current will be adjusted to the maximum load current level.
Limiter output voltage	Output voltage of the Limiter follows on the actual primary bus voltage (U_{bus}) in nominal operation. The Limiter's output voltage at the nominal maximum load current: $U_{Out} = U_{Bus} - 0.1$ V
Overcurrent	The current to the load will be limited by the Limiter to the trip-off (corner current) level. The trip-off current level will be higher by 30-40% of the Limiter maximal nominal current. The reaction time of the Limiter will be 2 ±0.5 microsec
Switch-off Delay Time	In case the load reaches the Limiter trip-off current and the output voltage decreases the 80% of the bus voltage the Limiter will be switched-off by PCU after a delay time of 10 ±1 msec
Inrush Current of the Load.	a) During the first short time period (0 – 5 microsec) the current rise shall be limited to 1 A/microsec by the load (passiv filter). b) During the following time period (till 9 – 11 msec) the current will be limited by the Limiter to the trip-off (corner) current level (see Fig. 4). During this period the load input voltage (identical with the Limiter output voltage) shall have reached its nominal value and the current shall have decrease to the maximal nominal current of the Limiter. c) The current shall be reduced by the load to its maximal specified value whithin a time period of less than 1 sec after load switch on.
Overvoltage Generation	In case of an inductive load, the user shall prevent an overvoltage generation (freewheeling diode). The maximal over voltage emission shall not exceed the limits between –1.2 Volt and 43 Volt.

Table 3-3 Current limiter switch characteristics

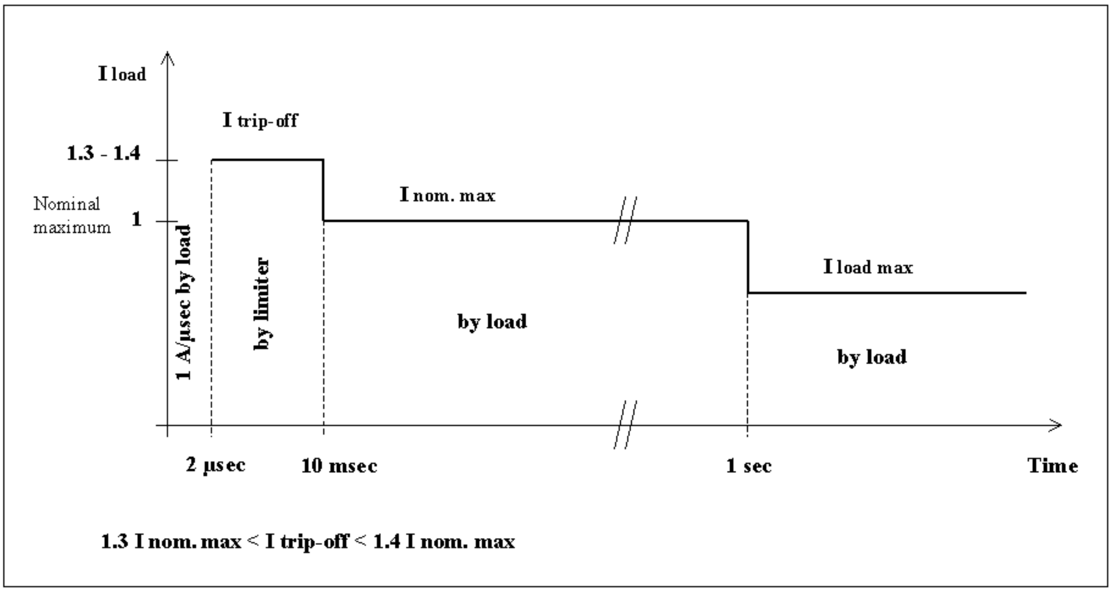


Figure 3-4 Current limiter switch characterisation

3.2.3 Transient at switch-on

The soft switch-on circuits deliver voltages to the experiments with the following parameters:

- risetime of the voltages 70 ±10 ms (for +5V TBC)
- relay actuating 100 ±10 ms
- steady state nominal voltages (100+5) ±10 ms

The falling edge of POD signal (power on delayed) indicates the reaching of the nominal voltage levels (see Fig. 5)

3.2.4 Ripple

Maximum ripple on the conditioned voltages < 0.1Vpp

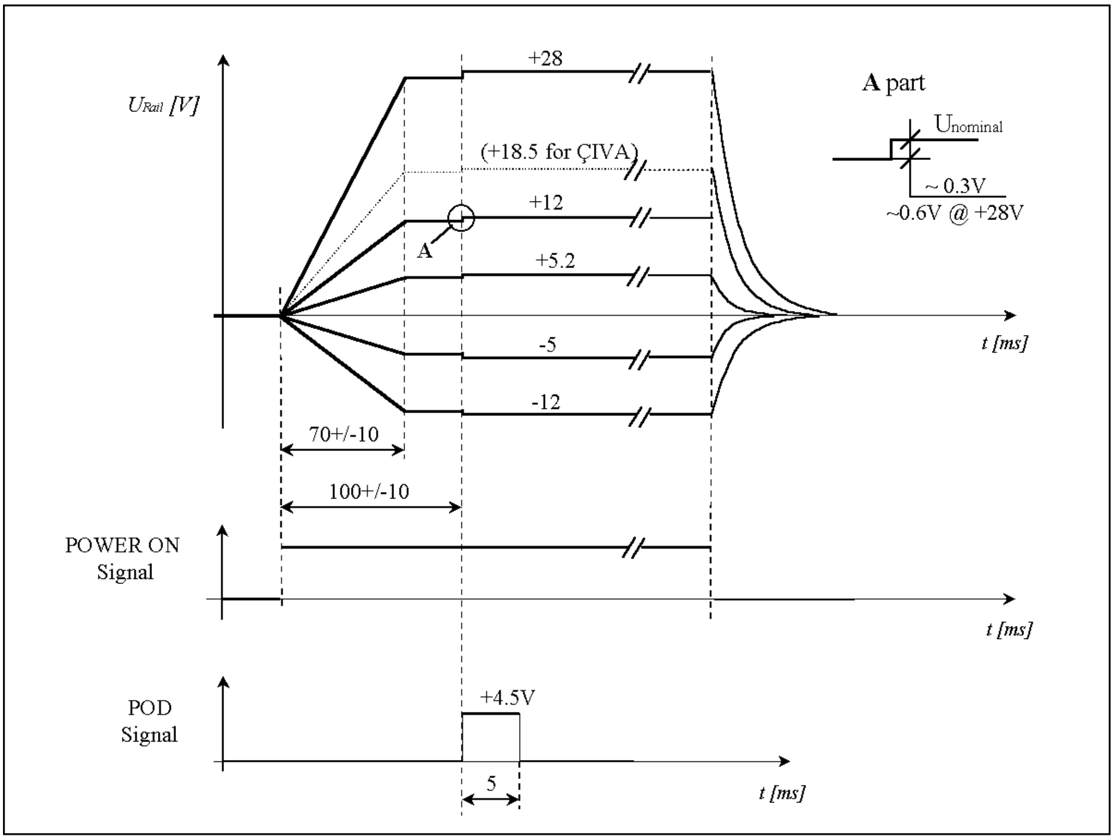


Figure 3-5 Timing diagram of the soft switch-on board

3.3 Keep alive line (5VKAL) interface

3.3.1 General

A low power keep alive line can be provided to the users upon request.

Under nominal conditions this line is constantly powered from the Lander auxiliary converters (AUX PS 1,2) regardless of the equipment on/off status.

The nominal voltage of ‑5VKAL is 5.0V at I_L = 0mA, and 4.0V at I_L = 2 ‑mA (Short circuit current: I_{SH} = 10 mA).

3.3.2 Redundancy

The 5VKAL signal is generated by the redundant ‑AUX PS 1,2 converters (see Fig. 3-3).

3.4 Experimenters' responsibilities

All experiment power lines shall be passively filtered (see Fig. 3-1) at their input with an inductivity-capacity-inductivity filter in T configuration. The values of these elements are TBD.

The primary bus users have to limit the current rise after switch on to 1 A/microsec (passive filtering).

The input currents on all the five power lines will be measured (on the experiment's interface board, following the soft switch-on circuits) by the system and these signals will be accessible for the experiment for HK or other purposes. The parameters of these lines are in the following table:

Measured line	Equivalent output
+5.2V	+1V ≡ 0.5A
+12V	+1V ≡ 0.25A
+28V (+18.5V)	+1V ≡ 0.025A
-5V	+1V ≡ 0.05A
-12V	+1V ≡ 0.05A
POWER	+1V ≡ 4W

Table 3-4 House Keeping outputs

The experimenters have to sample all used lines (current/power HK) with 1% accuracy and TBD time resolution and shall transmit the measured values to the CDMS as part of their HK status block.

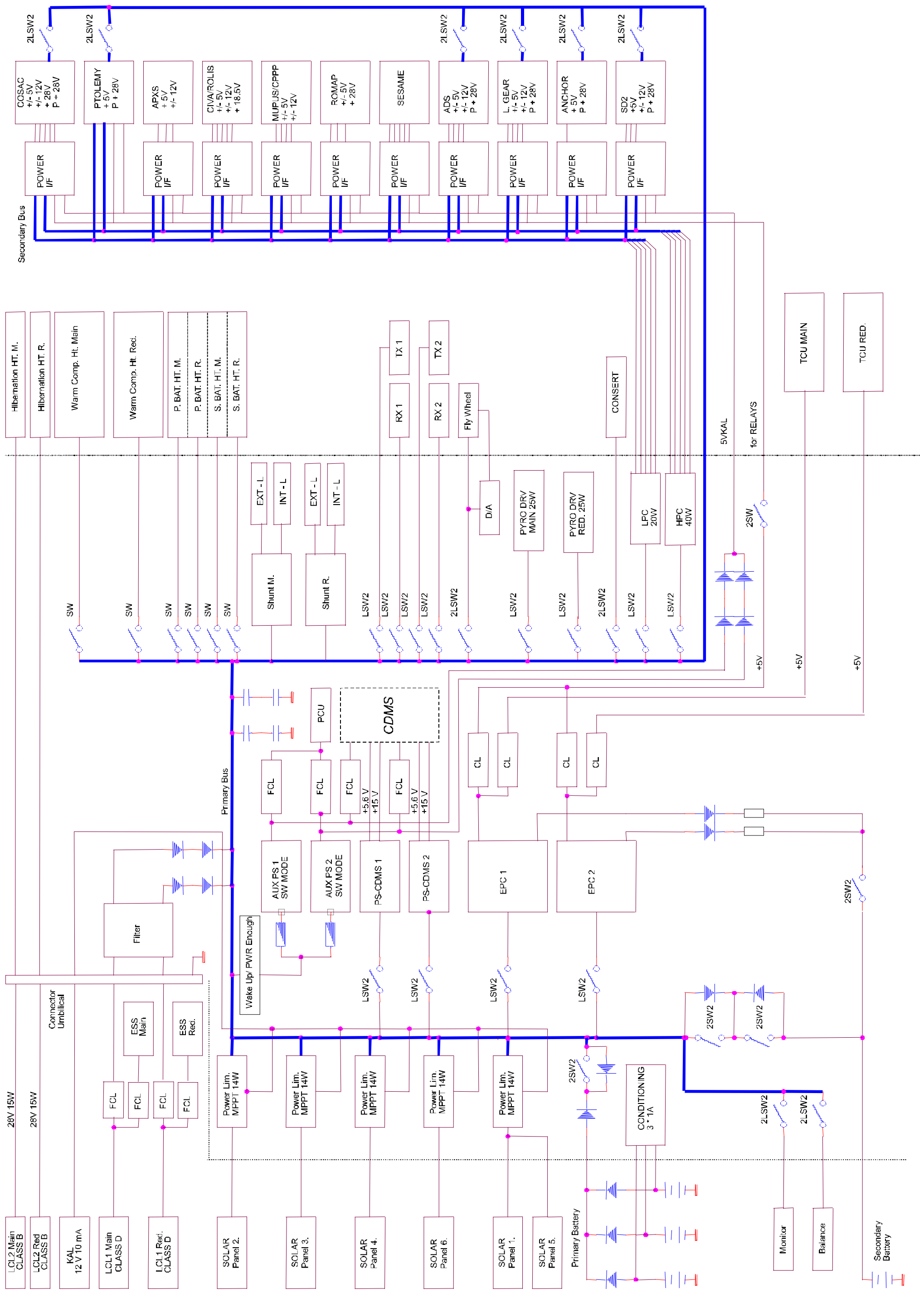


Figure 3-6 Power Sub-System block diagram

4 CDMS AND SUBSYSTEMS AND INSTRUMENTS

4.1 CDMS and Units

The major task of CDMS is to maintain overall control of the whole Lander complex and to organise information flow between them (Figure 4-1).

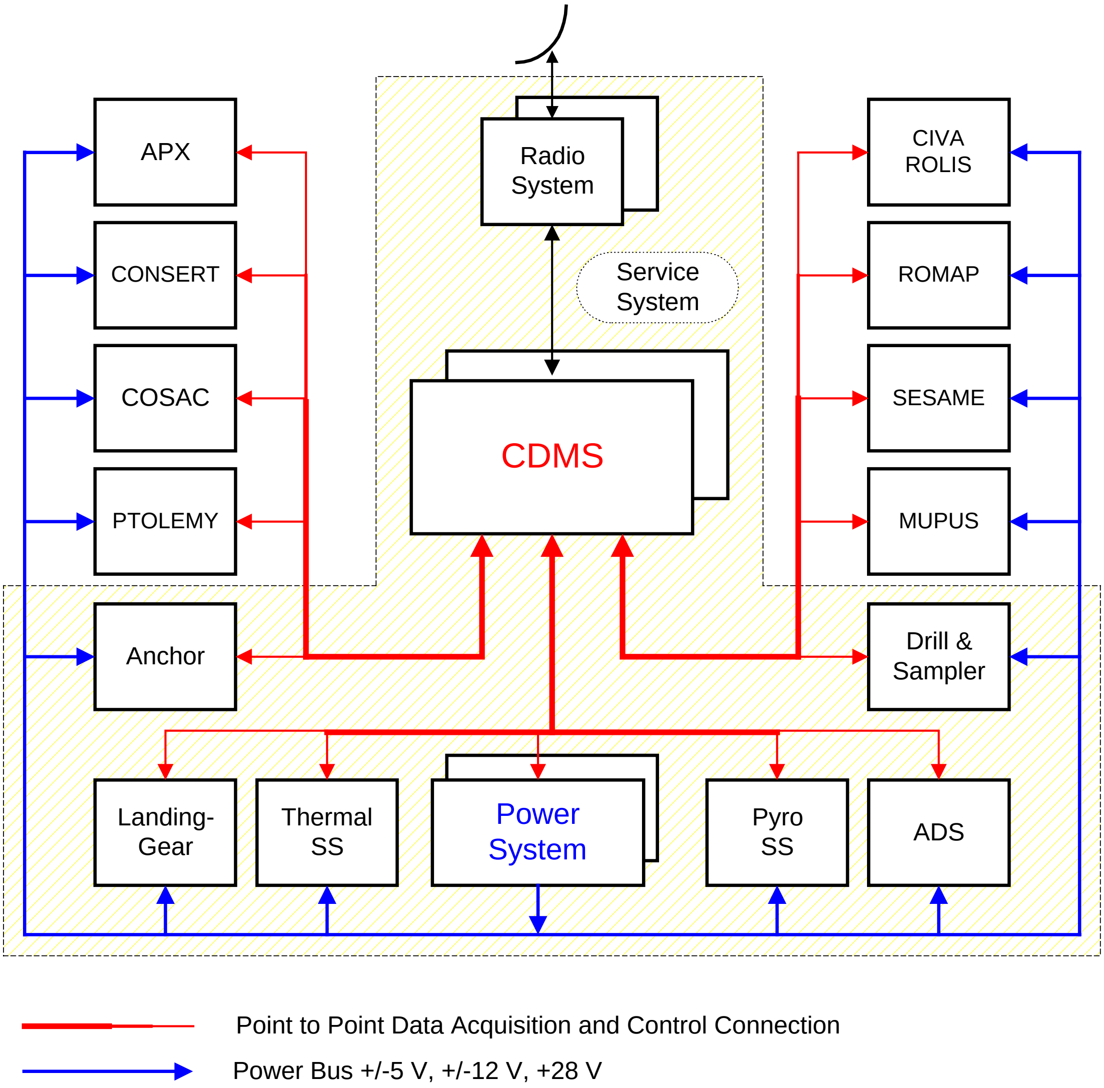


Figure 4-1 The general functional block diagram of the Lander

The CDMS itself does not perform any Unit-specific task or computation (as for the non-system related scientific instruments) rather it offers the Units numerous unified service functions so that they can fulfil their scientific objectives. Some of the CDMS services (actions) are initiated by the CDMS itself while some of them are activated upon Unit's request.

4.2 Data Flow and CDMS

4.2.1 CDMS as DPUs and CIUs

The CDMS can be divided into two main logical blocks (Fig. 4-2):
Digital Processing Unit (DPU) represents the intelligent part of the CDMS (processor, memories, etc.)
Central Interface Unit (CIU) is in charge of interfacing Units to the DPU (signal timing, generating synchron patterns, ..).

To avoid fatal consequences of a single point failure in the mission critical CDMS both DPU and CIU are redundant (DPU main/redundant, CIU main/redundant). It can be adapted to the eventually decaying health status of the DPUs & CIUs & Payload in such a way that CIUs can be operated in both cold and warm redundant modes. Cold redundant mode is preferable in order to save power, therefore the CIUs will be operated in cold redundant mode (per default CIU/main then CIU/redundant is on) until line errors appear on alternate CIUs. The main and redundant parts of DPUs and CIUs are connected together in such a way that they can work together in any combination. To minimise number of wires between DPUs and CIUs data is transmitted bitserially in both directions.

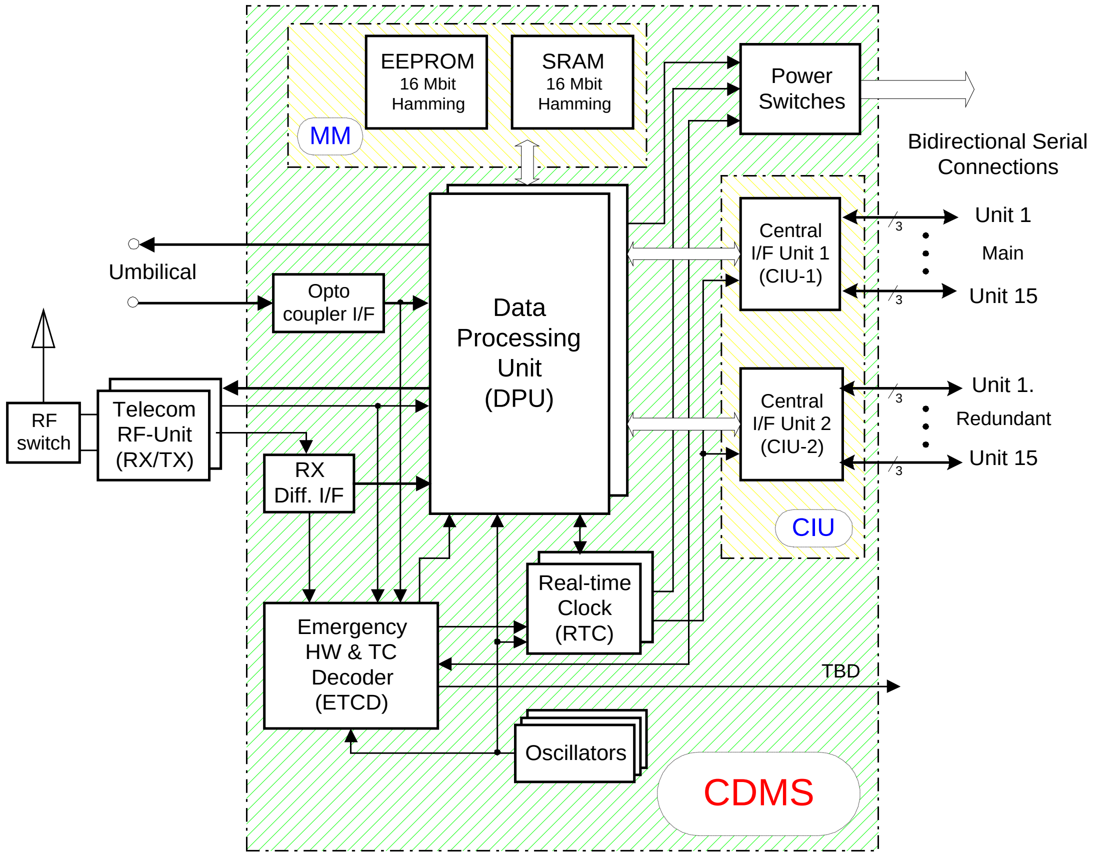


Figure 4-2 CDMS functional block diagram

DPUs, CIUs and payload constitute a star structure with the CIUs in its star point so that a failed Unit has no impact on the functionality of the system. The Unit's interface circuits to the CIU are called Remote Interface Units (RIU) ref. Figure 4-3

4.2.2 Unit's Interface Signals

A Unit is connected to (Figures 4-1, 4-2, 4-3) the CDMS through a main & a redundant of line sets:

- SSCLK/main, SSCLK/redundant (input)
  The basic timing signal, SSCLK is produced by the active DPU and distributed to all of the Units along with SSCMD and SSDAT lines via the active CIU. Frequency of SSCLK is four times of the real data transfer bitrate. It will be adapted to the varying operational conditions of the Lander in range from 64 through 131 072 Hz (TBC). Units shall remain fully functional at the different frequency of the SSCLK line.
- SSCMD/main, SSCMD/redundant (input)
  Serial data from CDMS(CIU) on word by word basis. Every single word is provided with specific synchron patterns in proper positions of the serial bitstream. Valid information bits are stable for the duration of four consecutive rising edges of the SSCLK with respect to the specific synchron patterns. Two different types of words are interpreted on this line: Subsystem Address Word concludes with SSADR Synchron Pattern, Subsystem Command Word concludes with SSCMD/DAT Synchron Pattern.
- SSDAT/main, SSDAT/redundant (output)
  .Serial data from a Unit to CDMS(CIU) on word by word basis. Valid information bits must be valid as it is prescribed in Figure 4-4 with respect to the specific synchron patterns observed on the SSCMD line. Two different types of words are interpreted on SSDAT line: Subsystem Status Word to be transmitted on SSDAT line starts with SSTS Synchron Pattern to be received on the SSCMD line, Subsystem Data Word to be transmitted on SSDAT line starts with SSCMD/DAT Synchron Pattern to be received on the SSCMD line.

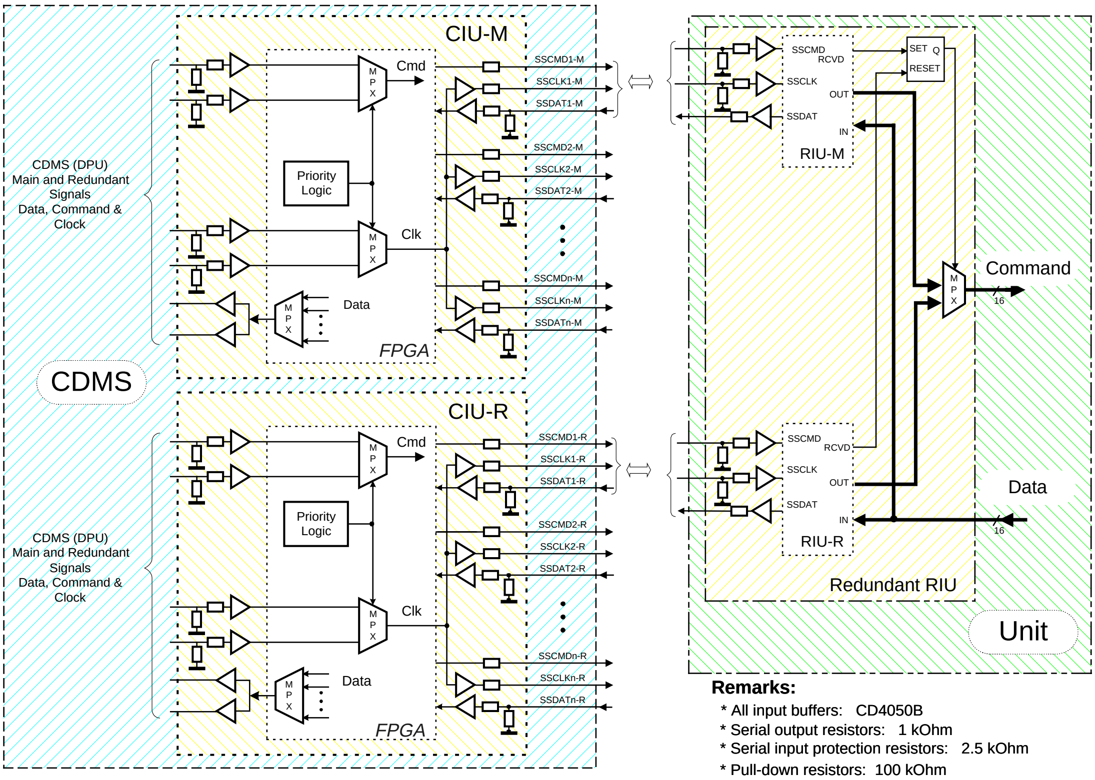


Figure 4-3 Electrical Interface between the CDMS and Units

The synchron patterns associated with the Subsystem Command Word and Subsystem Data Word are identical (SSCMD/DAT), moreover in different positions of the different words (either at the end or at the beginning). Whether to pick up SSCMD or to send away SSDAT can be decided on the basis of the T/R bit of the preceding SSADR word (ref. sections Word and Message Formats). The word terminating synchron pattern with the incoming data (SSADR, SSCMD) and the leading synchron pattern with the outgoing data (SSTS, SSDAT) eliminates the necessity of a bit counter (the shifted-in data can be clocked directly with the recognised synchron pattern) and therefore simplifies the Unit’s interface circuit considerably. (Ref. Fig 4-3 and Fig. 4-4)

4.2.3 Selection of CIU main/redundant in the Unit’s Interface

When communicating with CDMS, every single unit must adapt itself to the redundancy concept of CIUs. That is, RIU must be redundant as well regardless of the internal redundancy scheme of the Units. There is no direct line from CDMS to any Unit to determine whether CIU/main or CIU/redundant is the “true” one. Thus the Unit itself must take the decision on selecting main or redundant.

The general rule is: An addressed Unit shall be able to receive messages from both CIU/main and CIU/redundant. Response from the Unit to the CDMS (CIU) shall be sent onto that CIU where a message came from.

In redundant RIU scheme the signals of the one RIU (main) must be connected to CIU/main, while signals of the other RIU (redundant) to the CIU/redundant. It is still TBD, whether the SSCMD line connected to a particular Unit will carry messages that are meant for that particular Unit exclusively, or on the contrary, messages intended for some other Units will appear on the SSCMD line too. Therefore, triggering for the Subsystem Address field in the SSADR when receiving a message from CDMS must not be disregarded (ref. Word and Message Formats).

Figure 4-3 demonstrates a RIU scheme assuming a Unit with no internal redundancy. The incoming paralleled message words are multiplexed. Multiplexer selection signal can be derived from RIU/main and RIU/redundant respectively (where the message came from). As soon as the output data of the multiplexer becomes stable, the incoming data can be clocked. Outgoing parallel data must be connected to both RIU/main and RIU/redundant so that the requirement concerning Unit’s response is fulfilled.

4.3 Word and Message Formats

Serial data between CDMS and Units flows word by word. A word is composed of 16 bits, MSB (bit15) first. Four different types of words are interpreted from the viewpoint of the Units, for the identification of the word type there are extra clock bits (ref. .Figure 4-4)

- Subsystem Address Word to be received on the SSCMD line concludes with SSADR Synchron Pattern.Subsystem
- Command Word to be received on the SSCMD line concludes with SSCMD/DAT Synchron Pattern.
- Subsystem Status Word to be transmitted on SSDAT line starts with SSTS Synchron Pattern to be observed on the SSCMD line.
- Subsystem Data Word to be transmitted on SSDAT line starts with SSCMD/DAT Synchron Pattern to be observed on the SSCMD line.

4.3.1 Subsystem Address Word (direction: from CDMS to Units)

SSADR field
Subsystem Address field. A unique address for every single Unit.
Subsystem Address of ‘11111’ will indicate a Broadcast message. Whenever SSADR field is equal to ‘11111’, every single Unit is considered to be addressed.

T/R bit
Transmit/receive bit. If this bit is equal to ‘1’, the addressed Unit is expected to transmit information (Data Word(s)) to the CDMS. If this bit is equal to ‘0’, the addressed Unit is expected to receive information (Command Word(s)) from the CDMS.

ACTC/Subaddress field
This field defines the type of the actual message transaction.
Action Code/Subaddress values of 00000 through 01111, and 11111 are reserved for unified CDMS actions, called Action Codes.
Action Code/Subaddress values of 10000 through 11110 are reserved for direct register addressing, called Subaddresses. A maximum of 15 word wide register or register array can be addressed.

WRDC field
Word Count field defines either the number of Command Words to be received or the number of Data Words to be transmitted by the addressed Unit (Status Word excluded!). All zero represents number ‘32’.

4.3.2 Subsystem Command Word (direction: from CDMS to Units)

A 16 bit word containing any kind of data.

4.3.3 Subsystem Status Word (direction: from Units to CDMS)

SSADR field
Subsystem Address field. In this field every single Unit shall reflect its own Subsystem Address.

ME flag
Message Error flag. This flag shall be set to ‘1’, whenever the Action Code field of the Subsystem Address Word is illegal. The Message Error flag refers to the previous message transaction. The ME flag must be reset upon reception of a legal message. Transmit Status Word message must not reset ME flag.

CE flag
Count Error flag. This flag shall be set to ‘1’, whenever the received number of Command Words does not comply with the Word Count field of the Subsystem Address Word. The CE flag must be reset upon reception of a message with correct Word Count (‘TRSW’ excluded). Transmit Status Word message must not reset CE flag. Unit designers are requested to implement Word Count verification by hardware means.

SR flag
Service Request flag must change its state from ’0’ to ’1’, whenever CDMS is requested to perform an operation. The SR flag must be reset on reception of a ‘TRQC’ message from CDMS. A new Service Request from the Unit will be acknowledged only

- after CDMS has verified the 'reset' state of the SR flag by the routine acquisition of an SSTS word within the ‘TRQC’ message transaction.
- CDMS has completed all actions of the previous service request.

BSY flag
Busy flag. This flag must be set to ‘1’, whenever the addressed Unit is unable to perform any operation defined in the Action Code field of Subsystem Address Word. Any information acquired from the addressed Unit with Busy flag set to ‘1’ will be discarded by the CDMS.
As busy state may have undesirable impact on the CDMS operation, Unit designers are definitely requested to keep away from asserting busy states.

SM flag
Sleep Mode flag. If this flag is set to ‘1’, CDMS will issue an individual message with a standard Action Code, “Standby/Power Down Mode” (STBY), prior to each “Receive Telecommand Sequence” (RCMD) messages. The appearance of the leading ‘STBY’ message may trigger waking-up of the addressed Unit for the duration of the Telecommand reception.

4.3.4 Subsystem Data Word (direction: from Units to CDMS)

A 16 bit word containing any kind of data.

SSADR Subsystem Address Word (CDMS ⟶ Subsystem, Instrument)

15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
SSADR					T/R	ACTC / Subaddress					WRDC				

Subsystem Address; Transmit/Receive bit; Action Code / Subaddress; Word Count

SSCMD Subsystem Command Word(s) (CDMS ⟶ Subsystem, Instrument)

15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
16 bit DATA															

SSTS Subsystem Status Word (CDMS ⟵ Subsystem, Instrument)

15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
SSADR					ME	CE	SR	1	0	0	0	BSY	SM	0	0

Subsystem Address; Message Error Flag (ME); Count Error Flag (CE); Service Request Flag (SR); Busy Flag (BSY); Sleep Mode Flag (SM)

SSDAT Subsystem Data Word(s) (CDMS ⟵ Subsystem, Instrument)

15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
16 bit DATA															

Figure 4-4 Word Formats

4.4 Message Formats

Series of various types of consecutive words travelling between CDMS and Units constitute messages. Every single message transaction is initiated by the CDMS and always begins with a Subsystem Address Word. The bit fields and control bits of the Subsystem Address Word define the process of message transaction unambiguously. The Subsystem Address Word will be interpreted by the CIU and then proper number of synchron patterns (SSADR-, SSCMD/DAT-, SSTS Word Synchron Patterns) will be issued to the addressed Unit and at the same time outgoing/incoming information (message words) will be directed to the right destination. The message formats fall into three categories (ref. Figure 4-5):

Receive Command Words

The Subsystem Address Word (with T/R=‘0’) will be followed by WRDC (Word Count) number of Command Words. Immediately after the reception of the last Command Word the addressed Unit must respond with its Status Word. No Status Word response is expected in case of a Broadcast message (no SSTS Synchron Pattern will be generated by CIU).

Transmit Data Words

Immediately after the reception of the Subsystem Address Word (with T/R=‘1’) the addressed Unit must respond with its Status Word followed by WRDC (Word Count) number of Data Words.

Message Without Command or Data Words

Immediately after the reception of the Subsystem Address Word (with T/R=‘0’) the addressed Unit must respond with its Status Word. No Status Word response is expected in case of a Broadcast message (no SSTS Synchron Pattern will be generated by CIU). In this kind of messages the Action Code field of the Subsystem Address Word defines the action to be taken without the necessity of any Command or Data Word.

☞ The Subsystem Status Word serves also for verifying functionality of the Units therefore it is an inherent part of all message transaction (except broadcast messages), therefore special care must be taken on its actual field’s and bit’s settings. Since the Subsystem Status Word may be monitored by the CDMS at any time therefore it shall be held in a hardware register being ready to be shifted-out all the time.

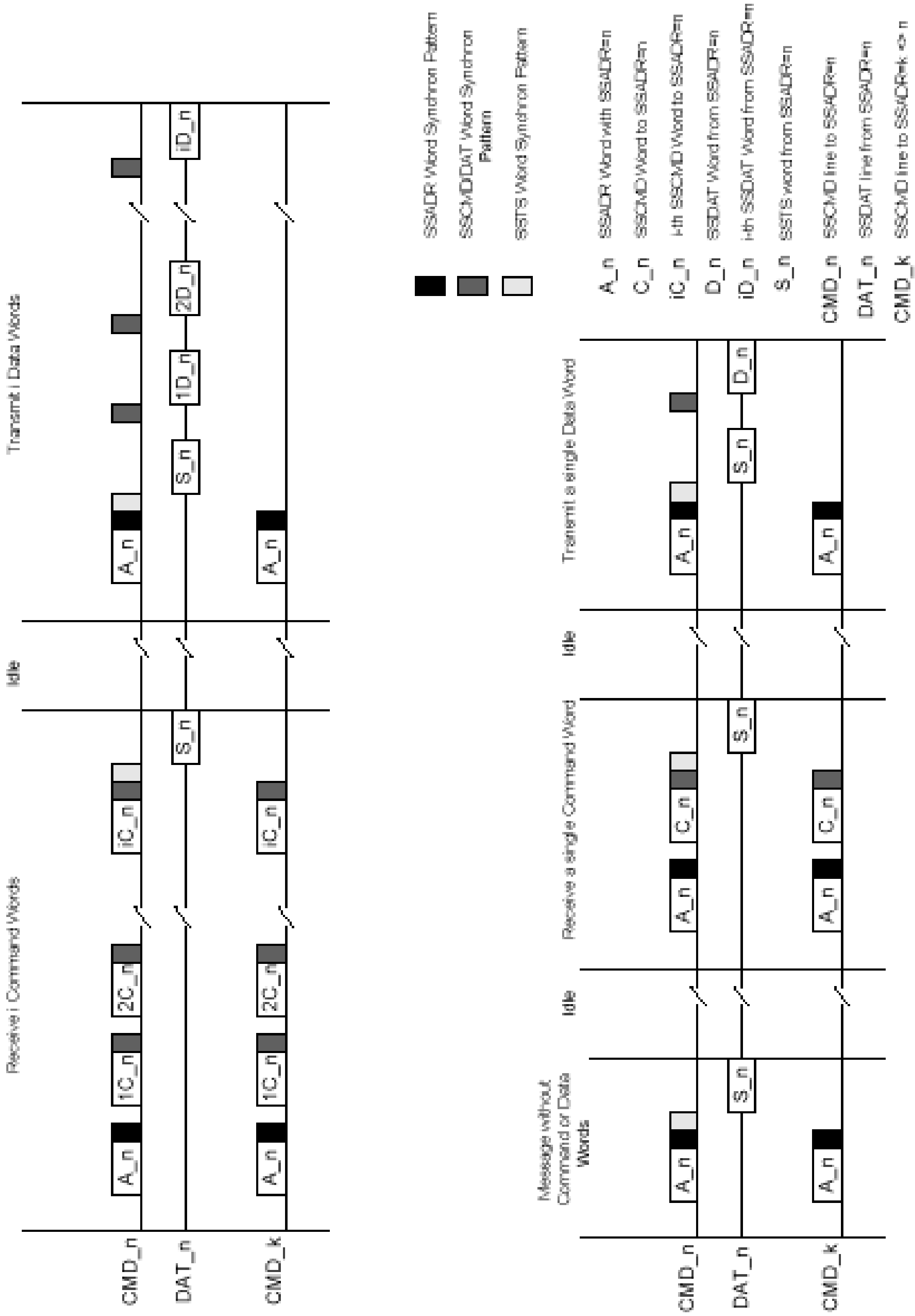


Figure 4-5 Message Formats

4.5 Timing Diagrams

The basic timing signal, SSCLK is distributed to all of the Units along with SSCMD and SSDAT lines. Frequency of SSCLK is four times of that of the bitrate on CMD and DAT lines. It will be adapted to the varying operational conditions of the Lander in steps of powers of 2 in range from 2^6 Hz through 2^{17} Hz (TBC). Units shall remain fully functional regardless of the varying frequency of the SSCLK line. Units will be notified of changes with an 'RMOD' message. The pause (zero state) between two consecutive words within a message is equal to one bit slot. Serial data is transmitted on word by word basis, 16 bits, MSB (bit15) first, with leading or trailing Synchron Patterns (ref. Figure 4-6).

- The SSADR Synchron Pattern can be identified by observing 1,0,0,1 logical states at four consecutive rising edges of the SSCLK.
- The SSCMD/DAT Synchron Pattern can be identified by observing 0,1,1,0 logical states at four consecutive rising edges of the SSCLK.
- The SSTS Synchron Pattern can be identified by observing 1,0,0,0,1 or 0,1,1,1,0 logical states at five consecutive rising edges of the SSCLK.

Valid information bits on the SSCMD line (for Subsystem Address or Subsystem Command Words) will remain stable for the duration of four consecutive cycles of the SSCLK with respect to the terminating SSADR or SSCM/DAT Synchron Patterns.
Information bits on the SSDAT line (for Subsystem Status or Subsystem Data Words) must be valid from the first rising edge till the second falling edge of the SSCLK in the bit slot with respect to the leading SSTS or SSCMD/DAT Synchron Patterns.

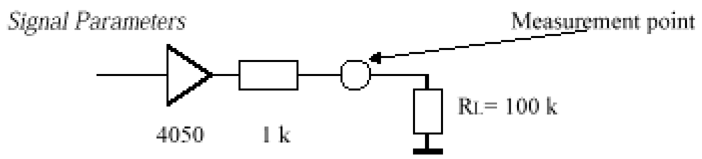


Figure 4-6 Measurement scheme

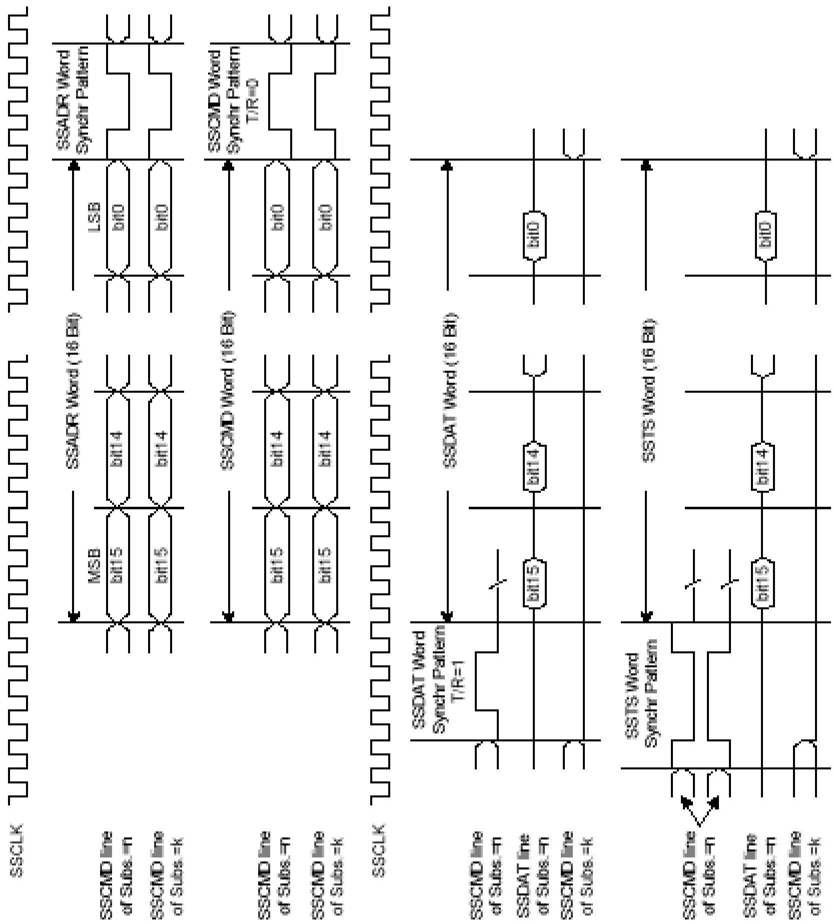
Signal levels on SSCLK, SSCMD as well as SSDAT lines must correspond to the standard CMOS levels:

4 V < Vhigh(logical one) < 5 V
0 V < Vlow(logical zero) < 0.4 V

- There will be no change in the logical state of the SSCMD signal within the range of ±2µsec with respect to any rising edge of the SSCLK signal.
- Information bits on the external SSDAT output line must become valid within 1µsec with respect to the corresponding rising edge of the SSCLK signal observed on the external input line.
  Rise an fall-times measured on the measurement point of any signal at RL=100 kOhm shall be less than 250 nsec.

- Serial protection and pull-down resistors at line inputs and driver outputs must by all means be implemented as well as CD4050B input buffers so that unpowered state of the Units does not cause any damage or disturbance (CD4050B buffers do not have input protection diodes to VCC).

- Driving SSDAT line does not necessarily requires CD4050B buffer, any standard CMOS logic gate is applicable. Appearance of non-definite, intermediate logical states on SSDAT line for longer duration than 1 sec shall be prevented in both powered and unpowered states of the Units.



Remark: Subsystem Address (SSADR_15,14,13,12,11) = n <> k

Figure 4-7 Timing Diagrams

4.6 CDMS Services (Action- and Request Codes)

The Action and Request Codes are summarised in Table 4-1. Some of the Action- and Request Codes are initiated solely by the CDMS while others either by the CDMS or on Unit's request. Both lists may be extended with other codes in the future. Messages with BRD "yes" notation can be issued both as individual (addressed) and broadcast messages. According to the terminology of this document Units fall into two categories:

1. Intelligent Units

Intelligent Units, which will possess their own microprocessor, will by intention be controlled by means of the unified CDMS services (Action Codes). Action Code/Subaddress values of 00000 through 01111 and 11111 are reserved for unified CDMS actions, called Action Codes.

2. Non-intelligent Units,

which will not possess any microprocessor, will by intention be controlled by means of direct register addressing. Action Code/Subaddress values of 10000 through 11110 are reserved for direct register addressing. An internal register may be composed of a single or more words (register vs. register array). A single word register can be accessed (read or written) by single word messages (WRDC=1), while a register array by burst-like messages (1<WRDC•32).

- Note however, that unified CDMS Action Codes such as, Transmit Status Word, Receive Housekeeping Data Format Count, and Transmit Housekeeping Data Word must by all means be implemented in non-intelligent Units too, the rest is optional.

Code	Mnemo	Action Code / Subaddress	BRD	T/R	WRDC	CMD Word(s)	DATA Word(s)
00000	TRSW	Trm Status Word	No	1	void	—	—
00001	TRQC	Trm Request Code Word	No	1	1	—	Request Code
00010	STBY	Standby Mode / Power Down	Yes	0	TBD	TBD	
00011	RMOD	Rcv Current CDMS Mode	Yes	0	1	CDMS Mode; SSCLK	—
00100	RTIM	Rcv On-Board Time	Yes	0	2	On-Board Time Code	—
00101	RSST	Rcv Service System Status	Yes	0	TBD	Service Sys. Status	—
00110	RAXT	Rcv Action Code / Subaddress Extension	Yes	0	1	ACTC / Subaddress	—
00111	RHFM	Rcv Housekeeping Data Format Count	Yes	0	1	HK Format Count	—
—\\—	THKD	Trm Housekeeping Data Word	No	1	1	—	HK Data Word
01000	RCMD	Rcv Telecommand Sequence	No	0	n	Command Sequence	—
01001	TCMO	Trm Offset/Length of Stored Tcmd. Buffer Section	No	1	2	—	Offset; Length
—\\—	RCMS	Rcv Stored Telecommand Buffer Section	No	0	Length	Buffer Section	—
01010	RASV	Rcv Allocated Science Data Volume	No	0	2	Packet counts	—
—\\—	TSCR	Trm Science Data Burst	No	1	4; 32	—	Science Data Burst
01111	RSCS	Receive Science Data Packet Checksum	No	0	1	Check Sum	—
01011	RBUS	Rcv Allocated Backup RAM Buffer Size	No	0	1	Record count	—
—\\—	TBUP	Trm Pointer of Backup RAM Buffer Record	No	1	1	—	Unit, Pointer
01100	TBUF	Trm Backup RAM Buffer Record	No	1	32	—	Data Record
—\\—	RBUF	Rcv Backup RAM Buffer Record	No	0	32	Data Record	—
01110	TTRG	Trm Trigger Word	No	1	1	—	Dest. & Trigger
—\\—	RTRG	Rcv Trigger Word	Yes	0	1	Source & Trigger	—
01101	RERC	Rcv Error Code Word	No	0	1	Error Code Word	—

*** Subaddresses 10000 thru 11110 are reserved for direct register addressing of non-intelligent Units (TBD)

Code	Mnemo	Request Code
0001	SSST	Send Service System Status
0010	SCMD	Send Stored Tcmd. Buffer Section *
0011	SASV	Send Allocated Science Data Volume
0100	SRDY	Science Data Ready
0101	SBUS	Send Allocated Backup RAM Buffer Size *
0110	WRBF	Write Backup RAM Buffer Record *
0111	RDBF	Read Backup RAM Buffer Record *
1000	STRG	Pass Trigger Word *
1001	FLSP	Flush Last Science Data Packet

*** Bits15..8 of the Request Code Word are reserved for non-intelligent Units (TBD)

Error Code Word:

Bit0 Illegal Request Code
Bit1 Illegal Unit, Pointer, Offset, Length
Bit2 Request Code Undue
Bit3 Mass-memory Full
Bit4 Allocated Science Data Volume Exhausted
Bit5 Destination Unit Off
---

* May be Undue during RF visibility

Table 4-1 Action and Request Codes

Request may be indicated to the CDMS by raising the Service Request flag in the Subsystem Status Word. Upon identifying a request CDMS will issue a message, Transmit Request Code Word, towards the requesting Unit, so that the reason for request can be identified. Upon reception of this message the addressed Unit shall reset its Service Request flag.

☞ Non-intelligent Units may also indicate requests to the CDMS, i.e. on conditions such as emergency situation in the Power S/S, release and touchdown sensor from the Mechanical S/S, completion of the drilling, sampling, carousel positioning, and so forth. If however once the Service Request facility is implemented in a non-intelligent Unit then the Transmit Request Code Word (as Action Code) must also be implemented (as a register being readable by CDMS) so that the cause of the request can be verified by the CDMS.

- Send Service System Status (SSST)
  Ref. Action Code: Receive Service System Status
- Send Stored Telecommand Buffer Section (SCMD)
  Ref. Action Codes: Transmit Offset/Length of Stored Tcmd. Buffer Section
  Receive Stored Telecommand Buffer Section
- Send Allocated Science Data Volume (SASV)
  Ref. Action Code: Receive Allocated Science Data Volume
- Science Data Ready (SRDY)
  Ref. Action Codes: Transmit Science Data Burst
- Send Allocated Backup RAM Buffer Size (SBUS)
- Ref. Action Codes: Receive Allocated Backup RAM Buffer Size
- Write Backup RAM Record (WRBF)
  Ref. Action Codes: Transmit Pointer of Backup RAM Record
  Transmit Backup RAM Record
- Read Backup RAM Record (RDBF)
  Ref. Action Codes: Transmit Pointer of Backup RAM Record
  Receive Backup RAM Record
- Pass Trigger Word (PTRG)
  Ref. Action Codes: Transmit Trigger Word
  Receive Trigger Word
- Flush Last Science Data Packet (FLSP)

5 COMMON ELECTRONIC BOX

5.1 General Description

The intention for introducing a common electronic box (e-box) for the Rosetta Lander was to create a common mechanical and thermal environment for experiment and subsystem electronics (see Fig. 5-10). This not only should save mass, space and mechanical interfaces for individual housings but also should act as an EMC shield against disturbances from front-end electronics as well as adding extra radiation protection to sensitive parts. At the same time provision is given to supply each ‘customer’ with standard voltages on a common rail system, to pick up the data interface to the CDMS and to optionally connect to some dedicated signal or power lines. The I/F PCB containing a ‘soft switch-on’ circuitry as well as a mechanical top cover for each individual electronics package (machined to ‘customer’ requirements) will be supplied by the e-box provider (MPAe).

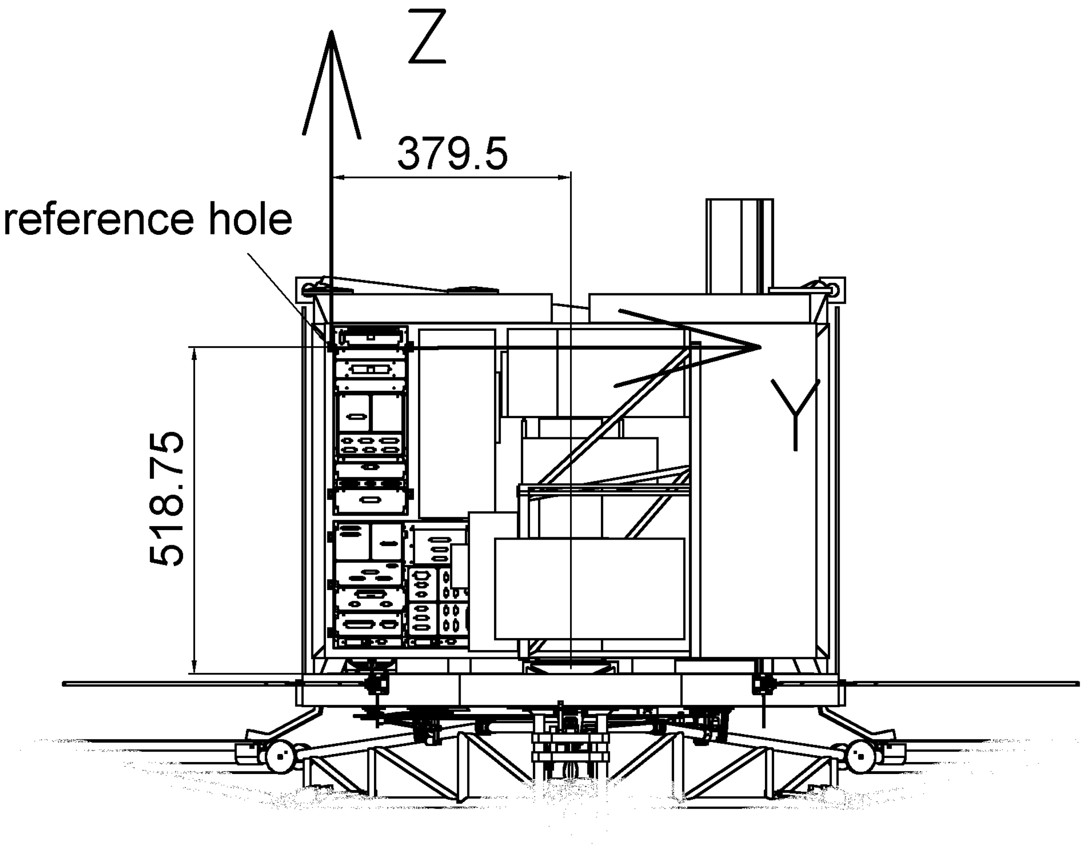


Figure 5-1 E-Box location on Rosetta Lander (front view)

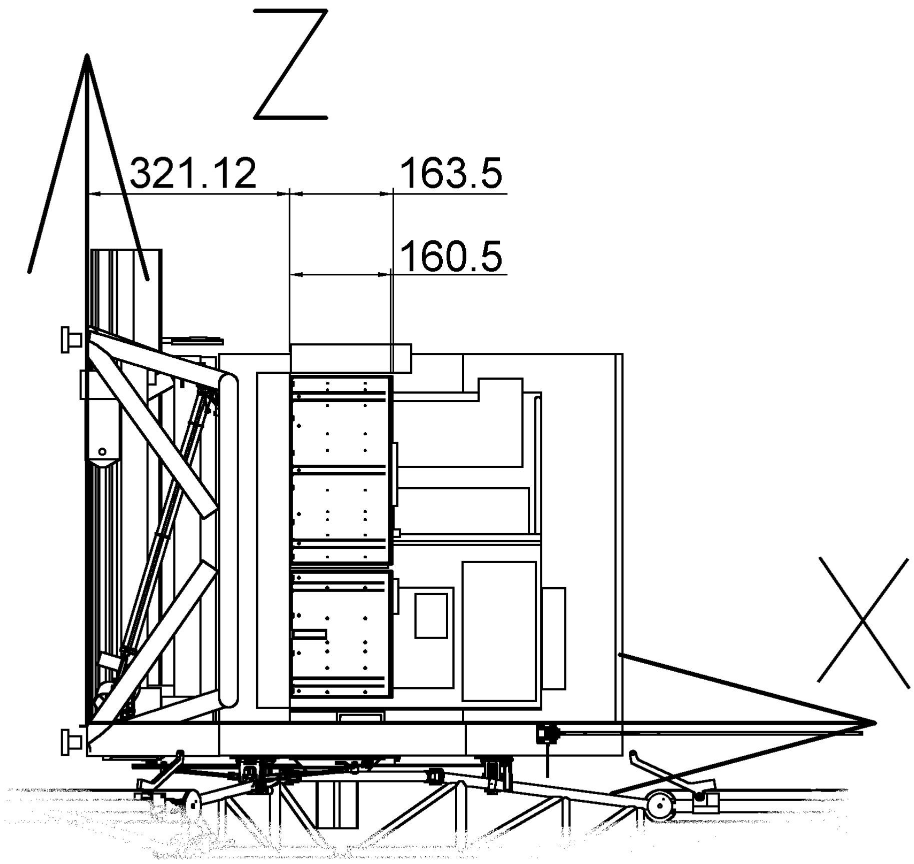


Figure 5-2 E-Box location on Rosetta Lander (side view)

5.1.1 Hardware Description

There are some limits and rules users have to adhere to:

the standard PCB size is 100 x 120 mm^2

spacing in between boards has to be in multiples of 2.5 mm

'length' of the stack is defined as the dimension along the number of boards (-Z - axis) and is referenced to the outward-facing (shielded) face of the I/F board

there is provision for space of approx. 20 mm above the electronic stack to interconnect experiment boards (see Fig. 5-3)

guiding rails to support the PCBs at their long sides will be e-box provided but each user has to state the thickness (± 0.2 mm)of each PCB. A clearance of 2.5 mm has to be left clear from the edge without circuitry or components

the boards will be limited in their downward direction, i.e. towards the motherboard, by a (Viton○) stop (see Fig. 5-6). Care should be taken to secure the boards against motion on the cover plate side.

(mounted directly to the cover plate, use of spacers to the cover plate, centre bolt for all PCBs or similar) a sample of an e-box mounted board stack is shown in Fig. 5-4 with details for determining dimensions explained in Fig. 5-5.

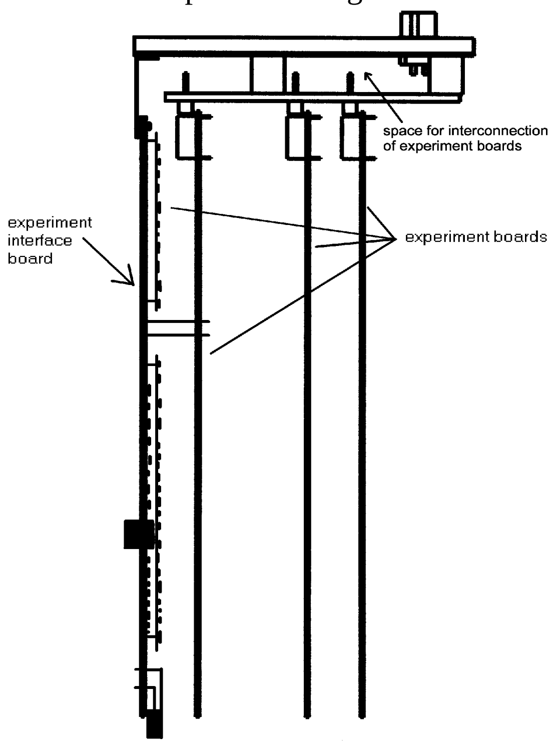


Figure 5-3 Experiment board stack (typical)

Looking from the top, the left side of the board stack is important to reference all dimensions. The left surface of the interface board is the reference point to locate the package in the electronic box. The left side of the top cover is located 3mm (+0/-0.1) left from the I/F board.

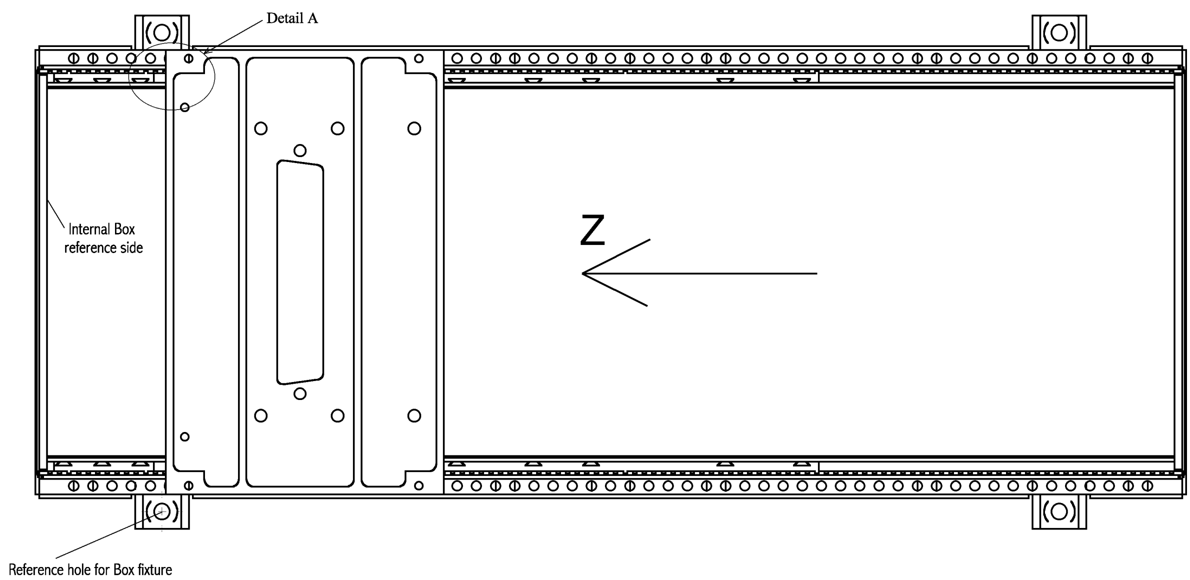


Figure 5-4 Complete Z-electronic box (top view)

Internal box reference is the inner side of the electronic box. There is no space left to the left side of the parts of the I/F board, so every board stack has to provide a min. of 1mm dynamic clearance at the right end (-Z) of the board stack to create some safety margin for vibration. The length of the cover plate should also be stated in steps of 2.5 mm.

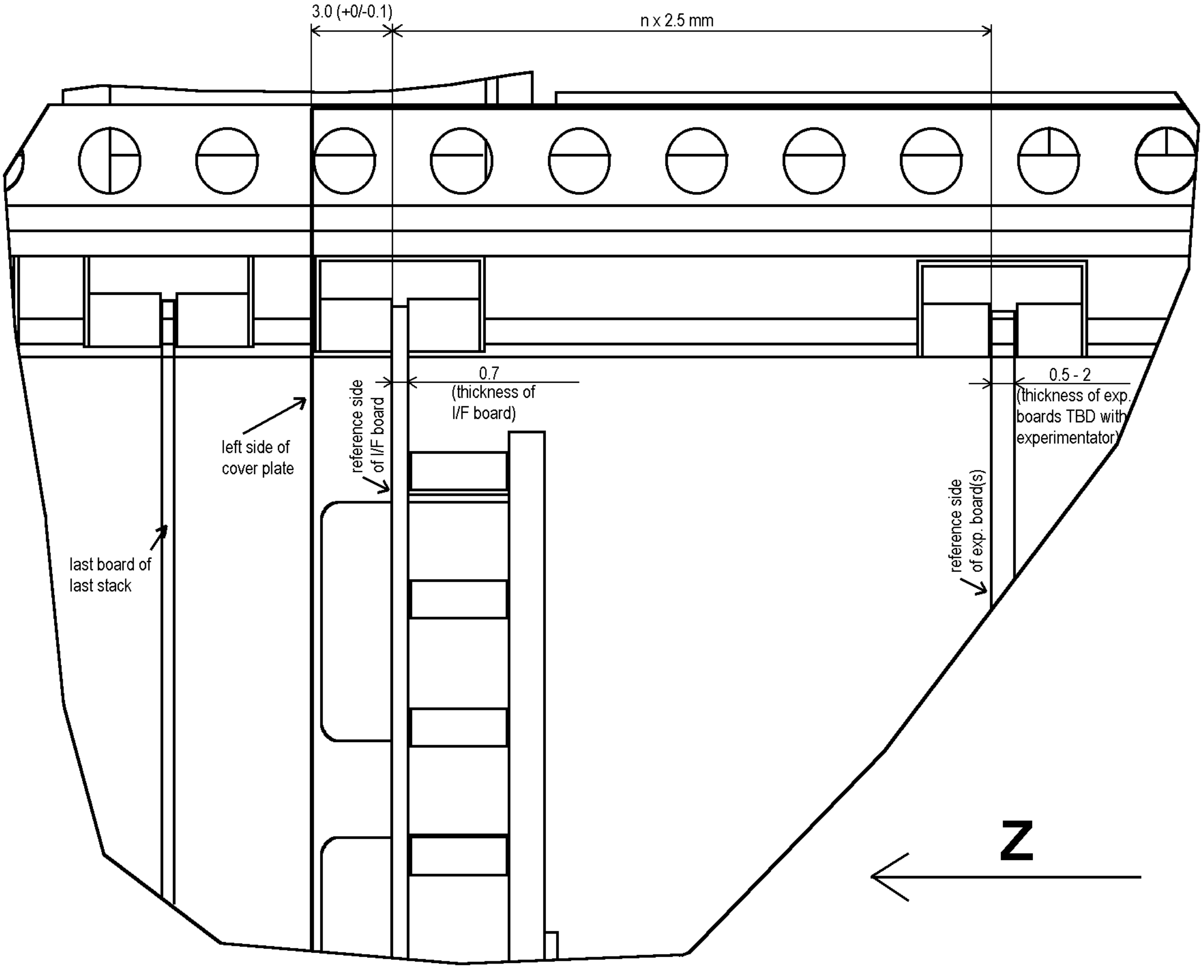


Figure 5-5 E-box detail A

The size for an experiment top cover depends on the length of the board stack. The left edge is located 3.0mm (+0/-0.1mm) left from the first electronic board's edge (reference side of experiment I/F board). The slots in the electronic box are offered in 2.5mm steps from reference side. The thickness of experiment boards can be 0.5 to 2.0mm and should be requested individually. A 2.5mm margin has to be left clear of copper tracks or components on both sides of your board(s) for guiding rails (see Fig. 5-8).

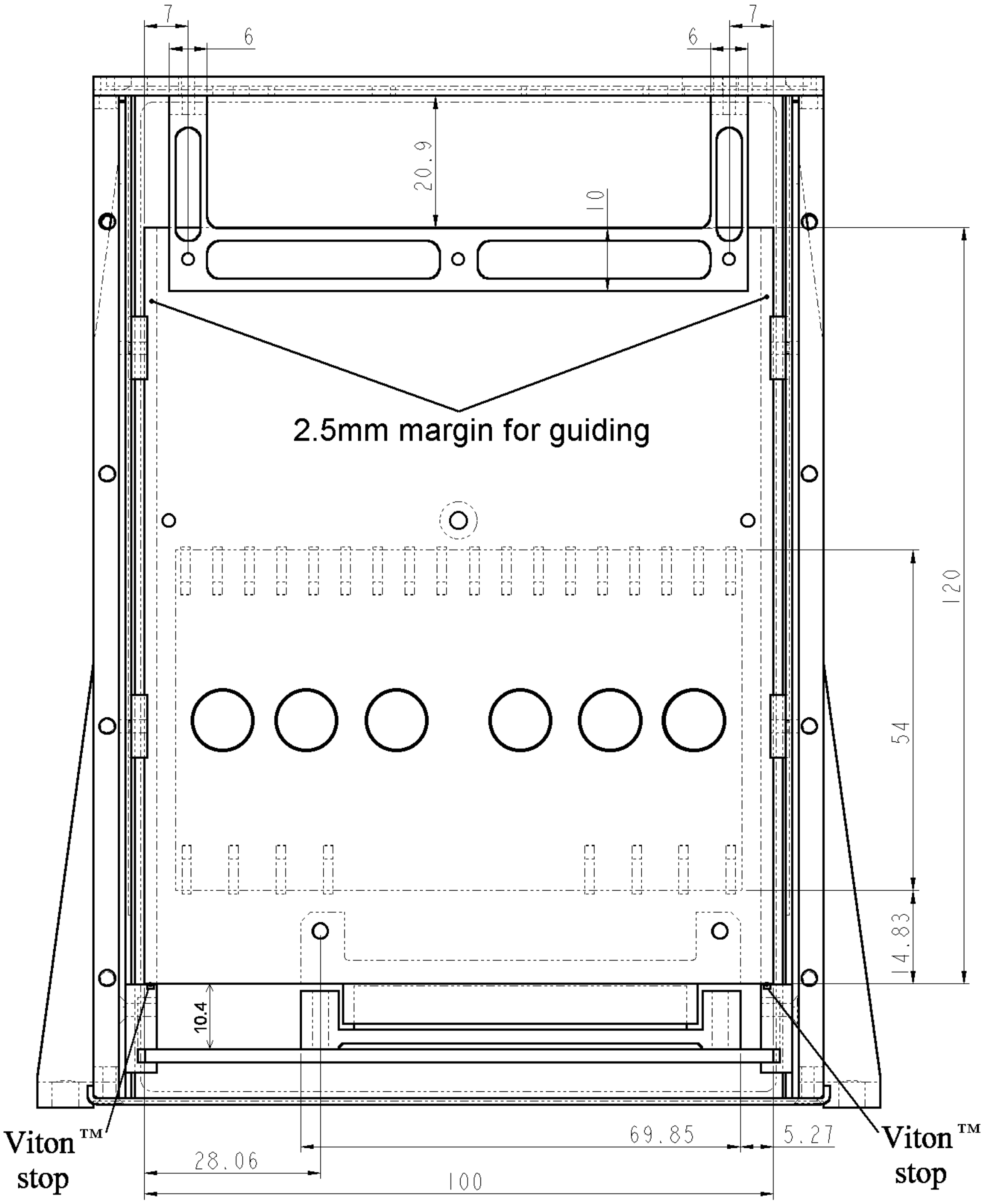


Figure 5-6 Mounted I/F board, viewed in –Z direction

Board size: width 100 mm, height 120 mm.
Above the board a space of 20.9mm is available for wiring and connectors.

The distance between the motherboard and I/F board is 10.4 mm (based on MALCO MCEM1-xx connectors). The same distance should be calculated for experiment boards and exp. Motherboard, when using MALCO MCEM1-xx connectors.

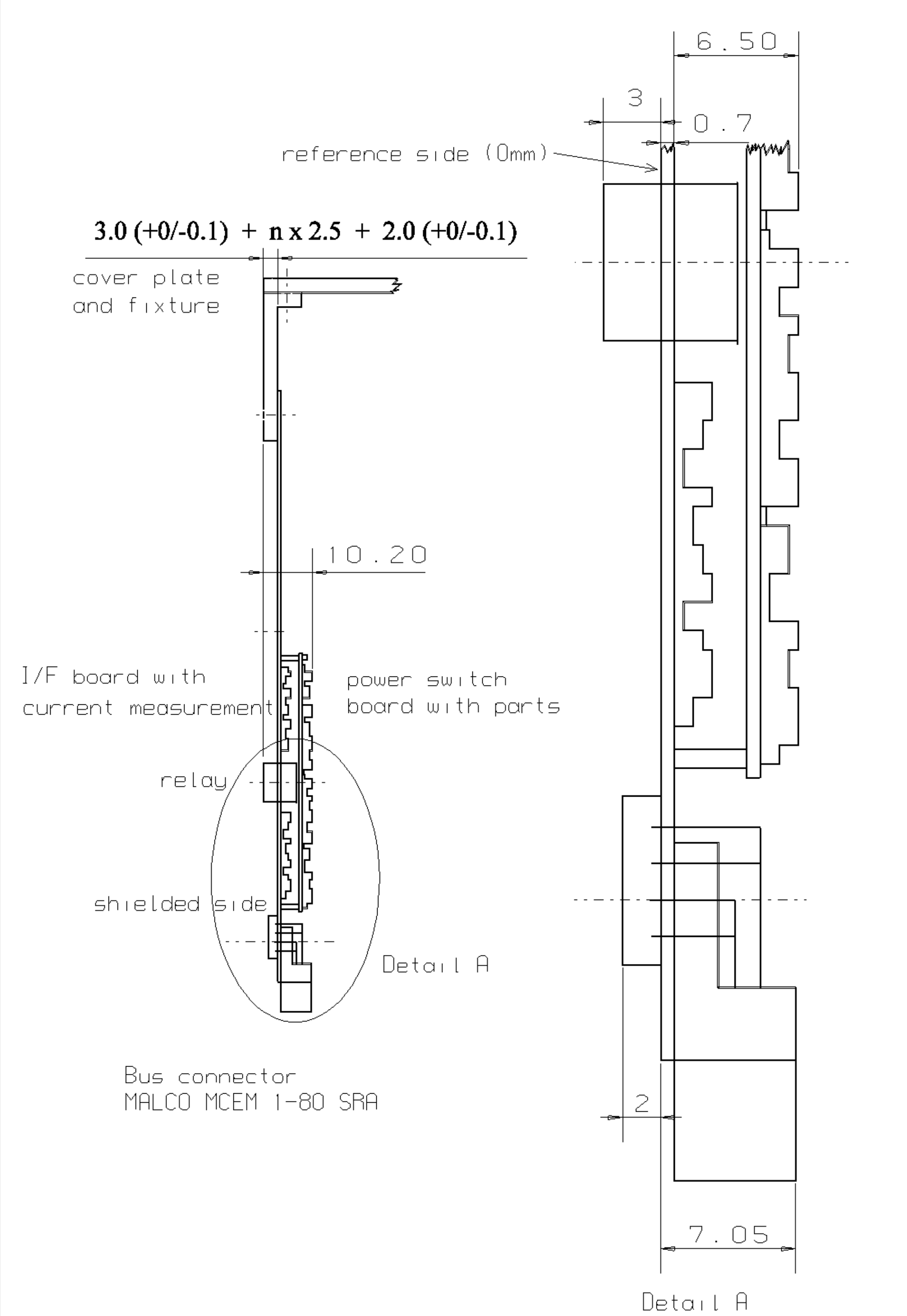


Figure 5-7 Dimensions of Interface and Soft Switch-on Board (side view)

On the left side of the board stack a space of 3 mm (+0/-0.1) is necessary. The I/F PCB contains a current measurement circuitry below the power switch board. For users taking advantage of the remaining space at the I/F PCB the available height for components is 5.5 mm (7.2mm-1.7mm space and thickness of IF/ board) without increasing the nominal slot space.

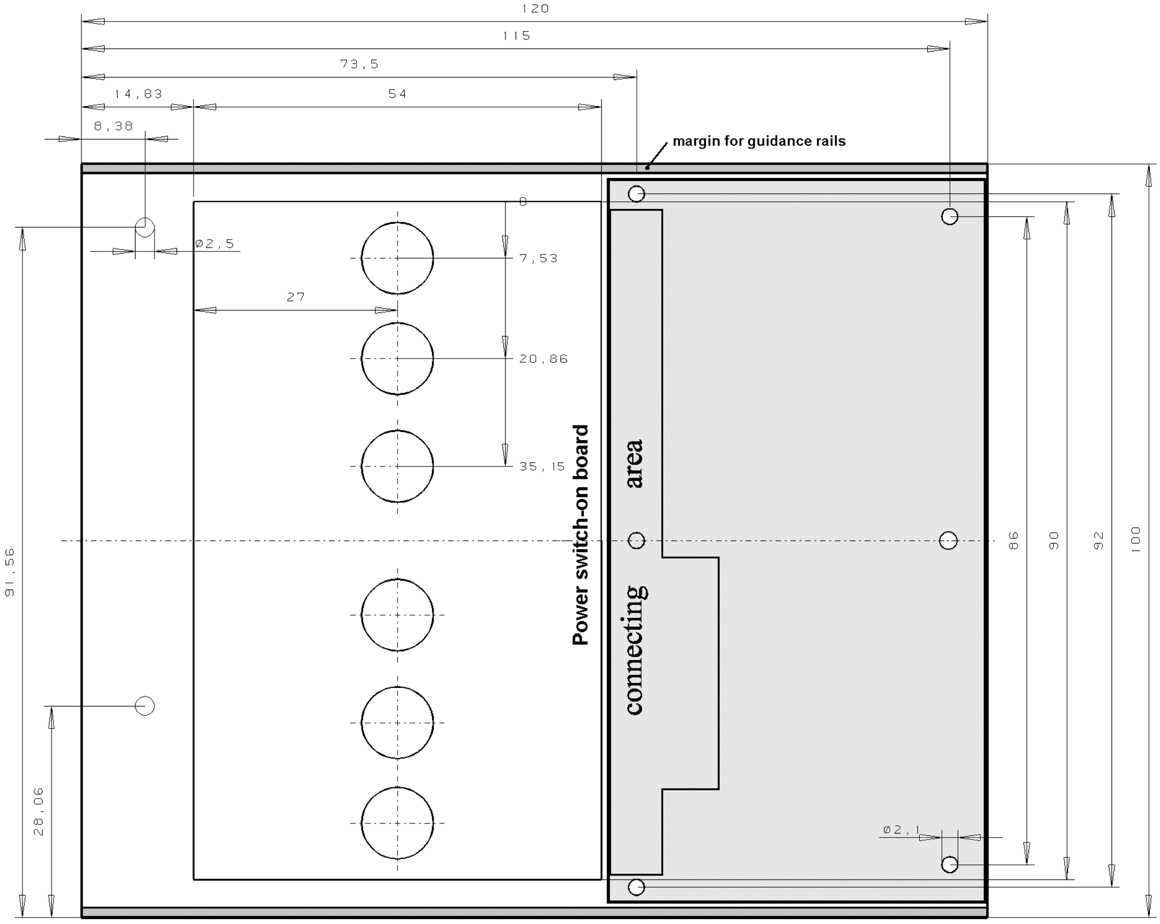


Figure 5-8 Lay-out of Experiment Interface and Power Switching Board

The thickness of the experiment interface board is 0.7mm. The height of the piggy back power switching board is 7.2mm from reference side. The shaded area indicates available space to the user for a small piggy back experiment board.

5.1.2 Deliverable parts to E-Box users

A principal of deliverable items of the E-Box team to experiments or subsystem to prepare EQM-Model is shown in Fig. 5-9.

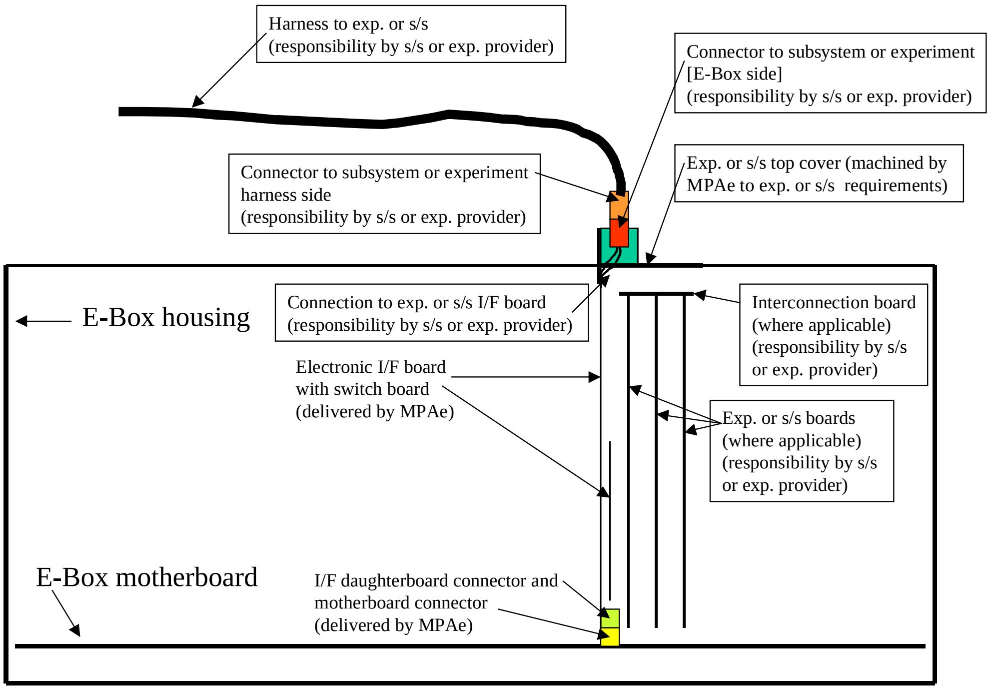


Figure 5-9 Exp. or s/s deliverable items for EQM

5.2 MECHANICAL

For the mechanical design guidelines and loads refer to sections 2.3 and 8.3.

5.2.1 Definition of Coordinate System (unit reference frame URF)

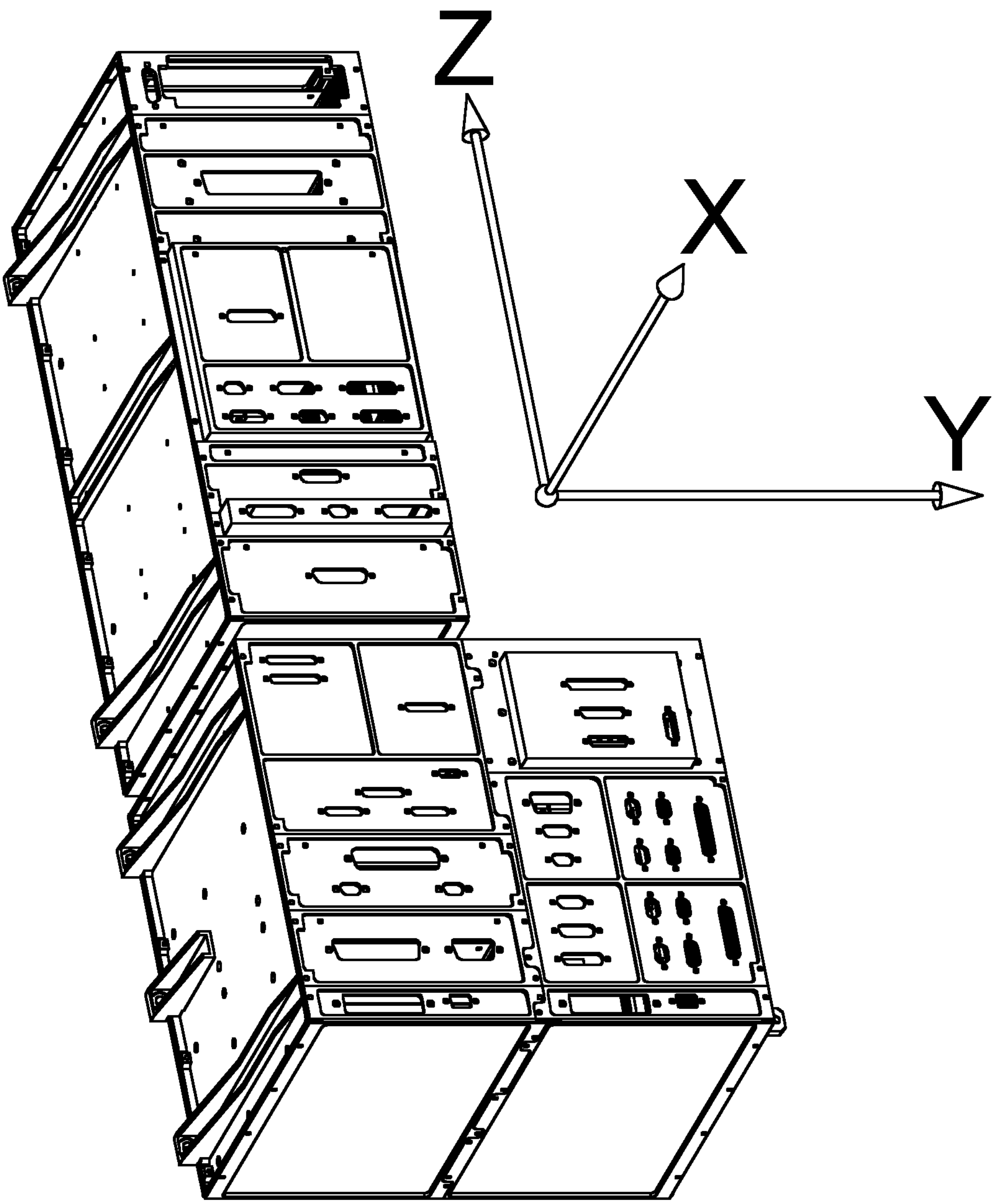


Figure 5-10 E-box and coordinate system

5.2.2 Technical Drawings

5.2.2.1 Mechanical Interface Drawings

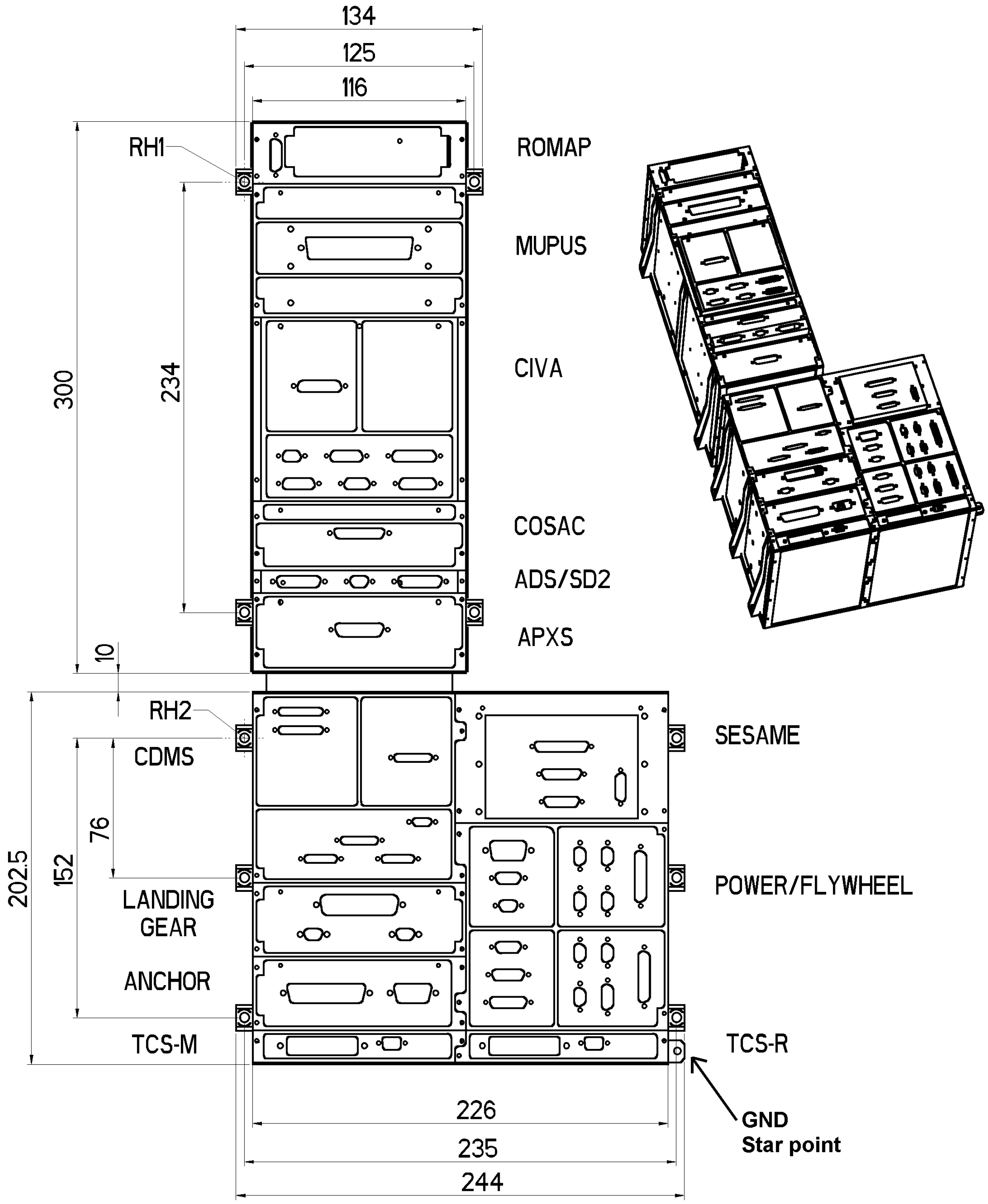


Figure 5-11 E-Box dimensions overview

5.2.3 Structural Design

5.2.3.1 Principle Design Concept

The structural parts of both electronic boxes are composed of aluminium alloy. This construction can be easily adapted to special requirements, like more space for particular experiments or special EMC-requirements.

5.2.3.2 Fixation Points

The fixation points are as defined in Fig. 5-11 of section 5.2.2.1of this document.

5.2.3.3 Dynamic Analysis (on system level only)

Compliance with EID-A requirements
The 80 Hz criterion in launch configuration will be demonstrated.

5.2.4 Mass Properties

Below you can see the mass Table 5-1. The masses are given for experiments and subsystems are all the design masses, so the final E-Box masses may change.

The masses of the empty E-Boxes including motherboard and guiding rails but without cover plates:

Z E-Box has a mass of 1.2 kg **TBC**
Y E-Box has a mass of 1.6 kg **TBC**

For E-Box dimensions, masses and centre of mass see Table 5-2.

Numbers of boards,space and mass of the ROLAND E-boxes Jul,27,1999

Experiment	No. of boards	incl. I/F	total no of grid á 2.5 mm	space [mm]	mass [kg] old	mass [kg] new	mass [kg] I/F board	E-box fee [kg]	total mass [kg]	margin 15% [kg]	total mass [kg] incl. Margin	comment
Z E-box												
ROMAP	2	3	12	30.00	0.14	0.25	0.08	0.08	0.42	0.06	0.48	mass incl. HV box on top
MUPUS	3	4	29	72.50	0.28	0.32	0.08	0.20	0.60	0.09	0.69	
CIVA	5	6	40	100.00	0.50	0.88	0.08	0.28	1.24	0.19	1.43	mass incl. Connectors
COSAC	1	2	15	37.50	0.74	0.18	0.08	0.11	0.37	0.05	0.42	
APXS	2	3	15	37.50	0.25	0.29	0.08	0.11	0.47	0.07	0.54	
SD2	0	0	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	Only softswitch on I/F from ADS
ADS	0	1	5	12.50	0.00	0.02	0.12	0.04	0.18	0.03	0.20	I/F together with SD2
actual total	13	18	116	290.00	1.91	1.94	0.52	0.81	**3.27**		3.77	
Y E-box												
CDMS	8	8	40	100.00	1.50	1.50	0.00	0.28	1.78	0.27	2.05	power from outside
Landing Gear	2	3	16	40.00	0.34	0.37	0.08	0.11	0.56	0.08	0.65	
Anchor	2	3	16	40.00	0.28	0.40	0.08	0.11	0.59	0.09	0.68	
TCS	1	1	6	15.00	0.10	0.17	0.00	0.04	0.21	0.03	0.24	power from outside
Y E-box												
SESAME	4	5	27	67.50	0.36	0.74	0.08	0.19	1.01	0.15	1.16	
PSS / Flywh.	8	8	45	112.50	1.60	0.00	0.00	0.32	1.92	0.29	2.20	
TCS	1	1	6	15.00	0.10	0.17	0.00	0.04	0.21	0.03	0.24	power from outside
actual total	26	29	156	390.00	4.28	3.35	0.24	1.09	**6.28**		7.22	

Interface board = 80g
E-box fee 28g for each cm (7g per grid)

Table 5-1 E-Box masses (all TBC)

Experiment	Total mass (kg)	Dimensions wrt URF axes (mm)			Centre of mass wrt Lander URF axes (mm)		
		x	y	z	x	y	z
Z E-Box	3.6 TBC	163.5	134	300	398.87 TBC	-317.1 TBC	396.75 TBC
		Dimensions wrt URF axes (mm)			Centre of mass wrt Lander URF axes (mm)		
		x	y	z	x	y	z
Y E-Box	6.5 TBC	163.5	244	202.5	400.82 TBC	-261.5 TBC	289 TBC

Table 5-2 mass properties

5.2.5 Mounting

5.2.5.1 Attachments, Footprints etc.

Z E-Box - *4xM5 Bolts TBC*
Y E-Box - *6xM5 Bolts TBC*

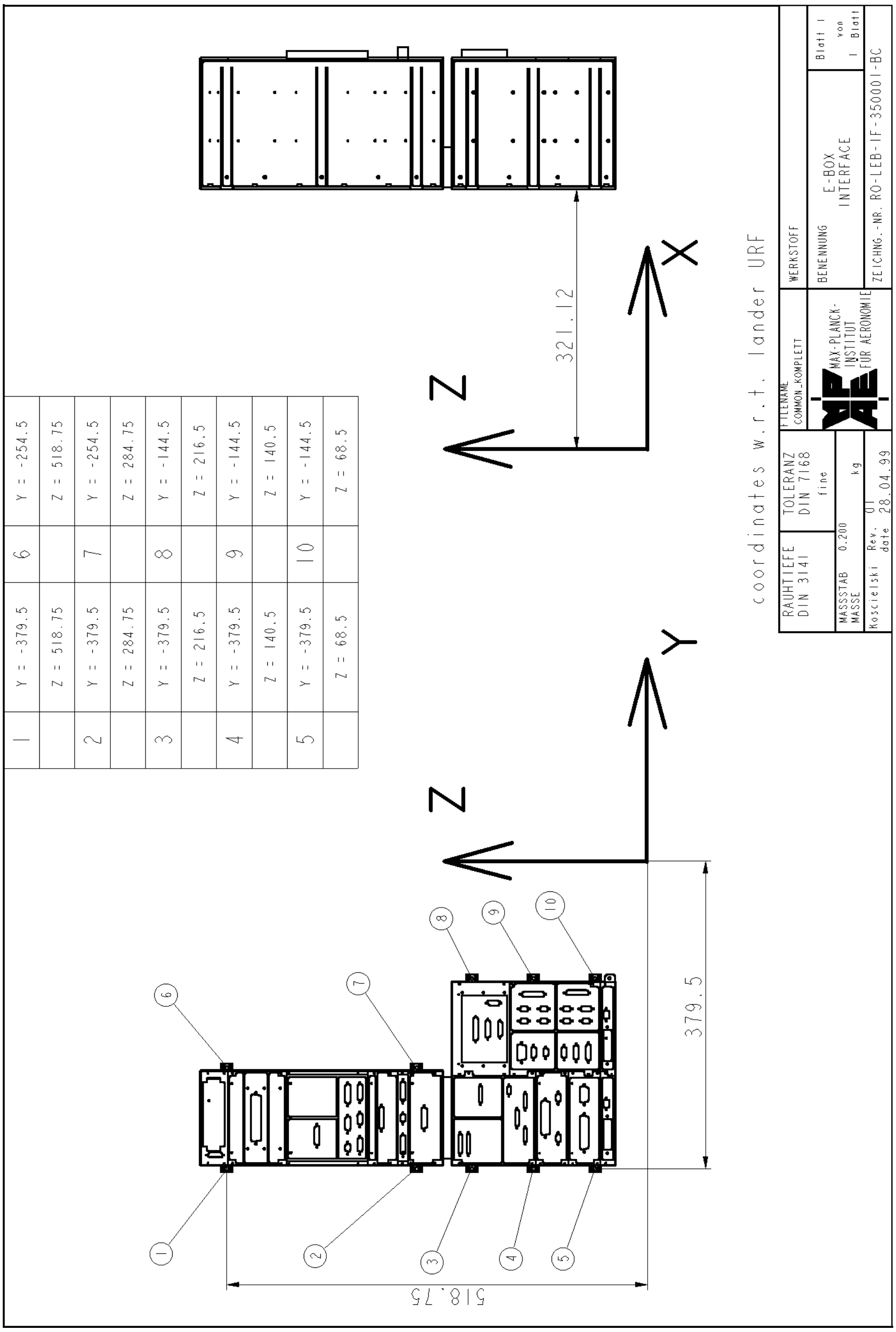


Figure 5-12 footprints of Lander E-Boxes

5.3 ELECTRICAL INTERFACE

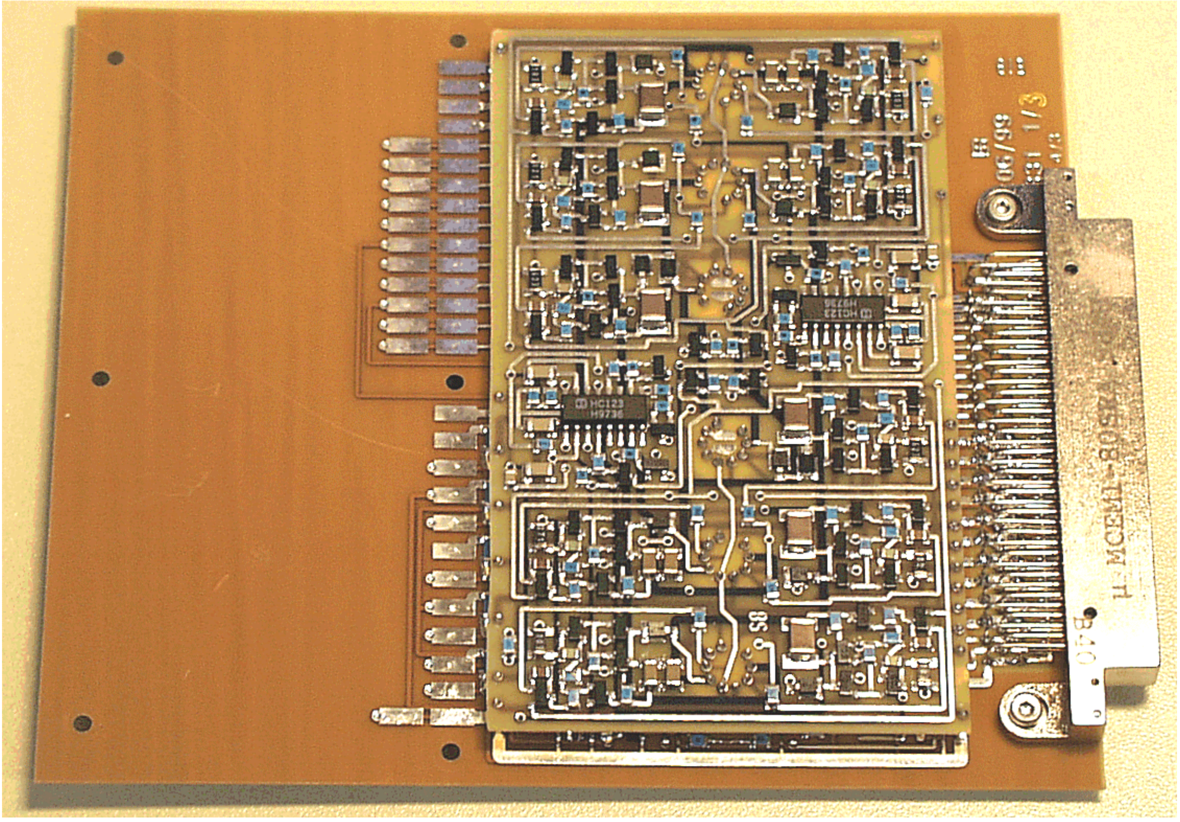


Figure 5-13 Picture of Electronic Interface Board (normal version)

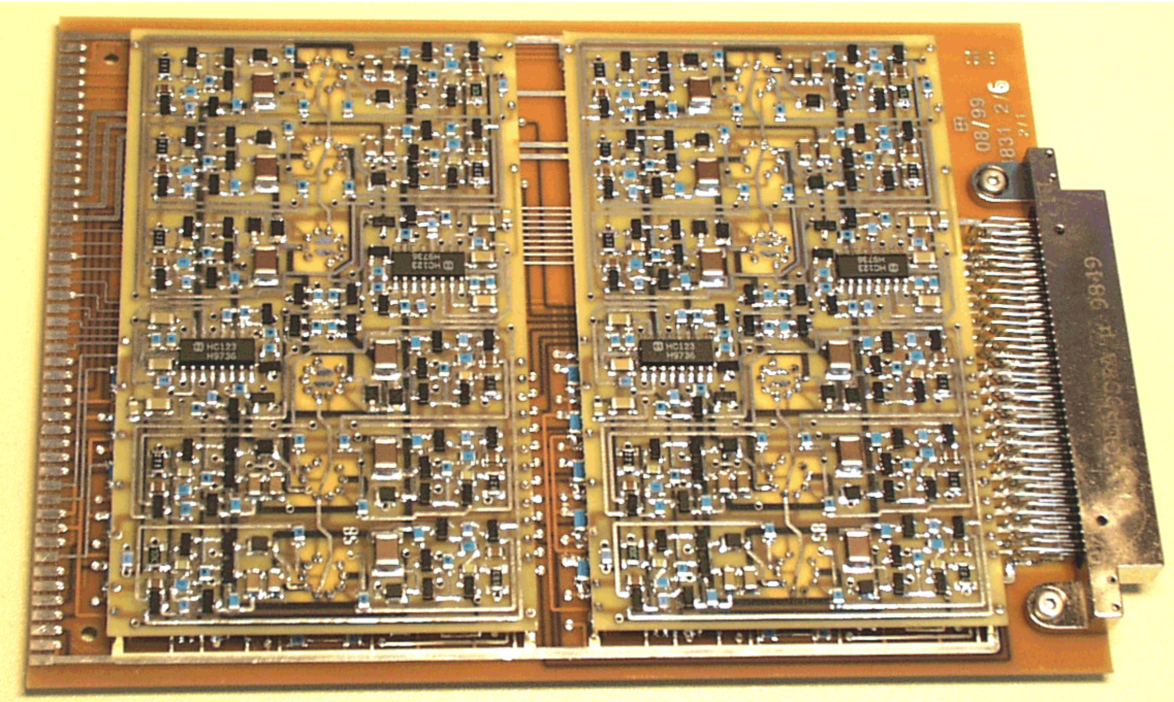


Figure 5-14 Picture of Electronic Interface Board (dual version only for ADS and SD2)

5.3.1 Power Supply Interfaces

For power supply interfaces see Fig. 5-17 (common version) and Fig. 5-18 for ADS/SD2.

!!! Before you give the ON-signal to the I/F board you should connect all the Voltages to the I/F board, no matter if you need all or not!!!

5.3.1.1 Power requirements

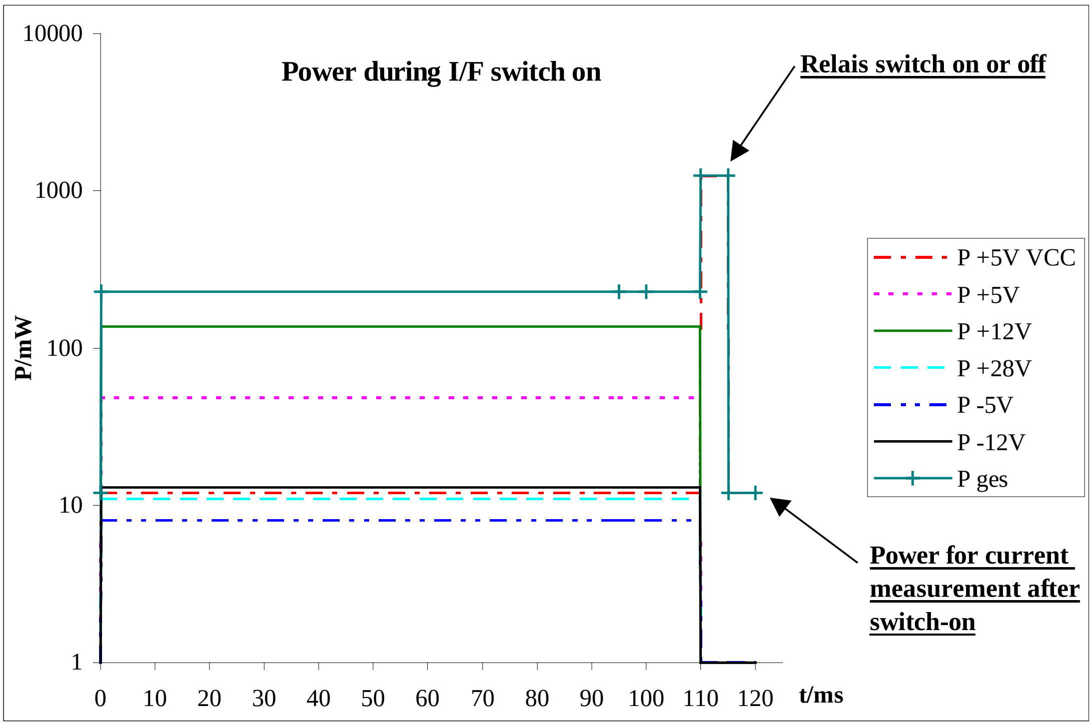


Figure 5-15 I/F board power consumption during switch on

Fig. 5-15 shows the power consumption of an experiment interface board during switch on.
The experiment or subsystem power has to be added.
For ÇIVA, which uses 18,5V instead of 28V, the $P_{+18.5V}$ is 213mW instead of 11mW for 28V.
After the relays have switched (at 115 ms), the power consumption of the Interface board is 12mW .

5.3.1.2 Voltages

The I/F board will provide ± 5 V, ± 12V and + 28 V (see Fig. 5.17 and Fig. 5-18)
(For ÇIVA +18.5V instead of +28V.)

For the rising of voltages see Fig. 5-16 (+18.5V only for Civa instead of 28V).

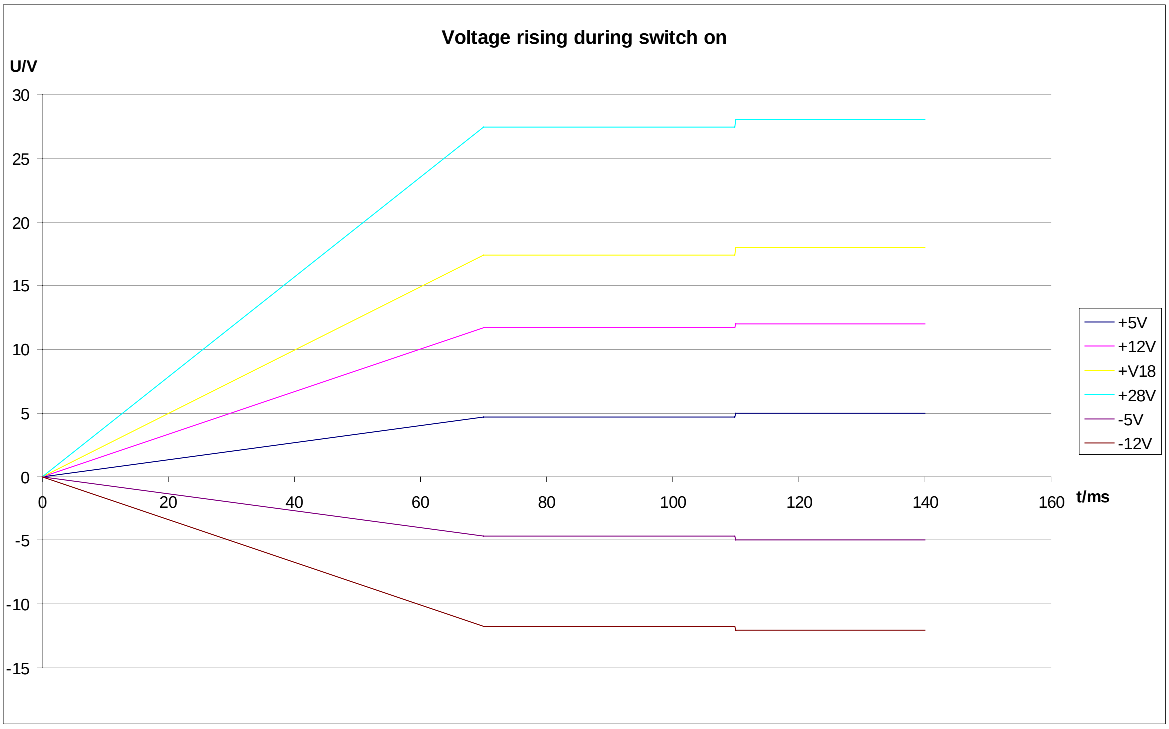


Figure 5-16 Voltage rising during switch on of I/F board

5.3.1.3 I/F to Lander CDMS

Most individual I/F boards are connected to CDMS via the motherboard. Separate Clock, Data and Command lines (main and redundant) are provided.

Individual lines for dedicated signals are foreseen and should be requested individually.

5.3.1.4 Description of subsystem electronics

Electrical Requirements

A lay-out of the printed circuitry of the experiment interface board is shown in Fig. 5-17 (for ADS and SD2 in Fig. 5-18) indicating to the user, where the pick-up points for voltages and signals are. For voltage and signal parameters, please refer to the respective chapters of REID-A, i.e. chapter 3 for ‘Power’ and chapter 4 for CDMS.

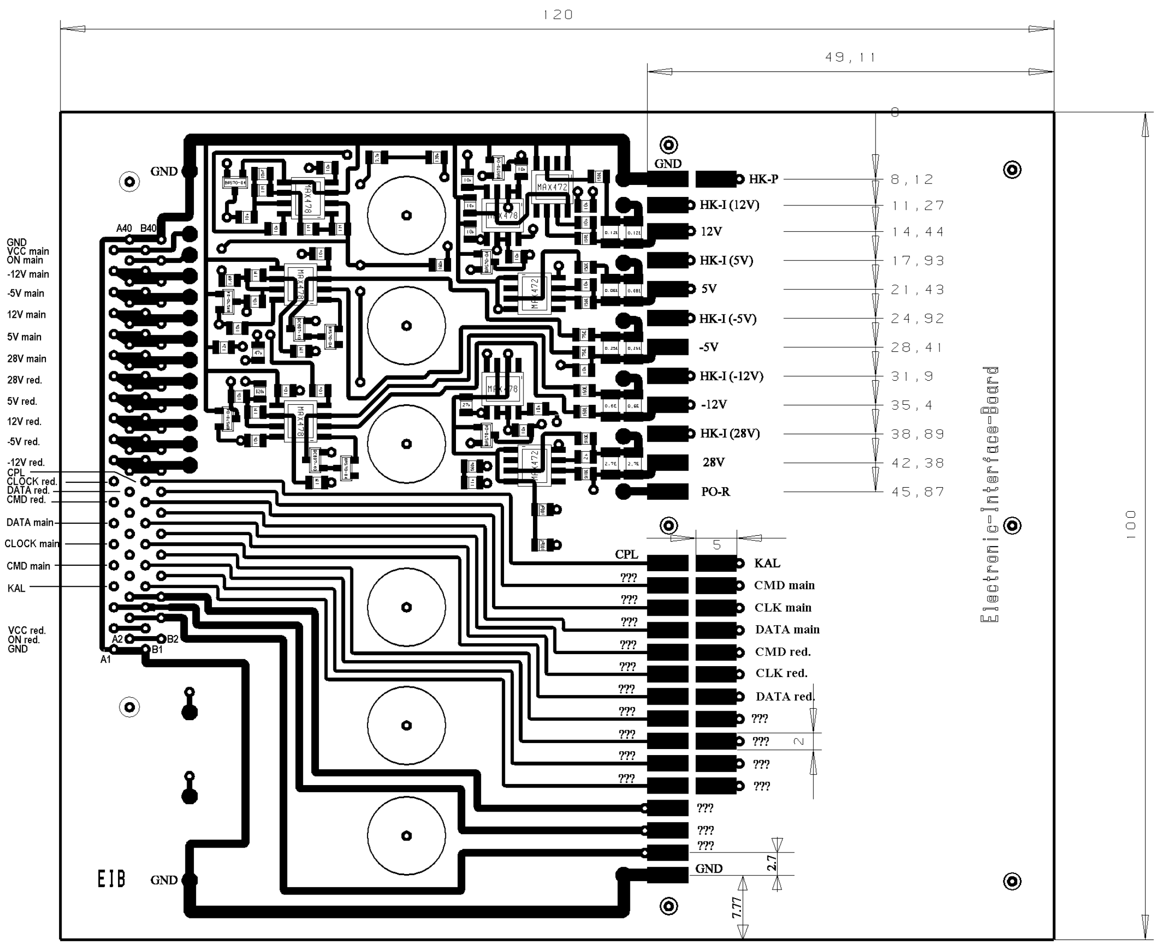


Figure 5-17 layout and connections of experiment interface board.

Experimenters can connect their boards to the pads on the right side. For the housekeeping outputs see section 5.3.1.5.

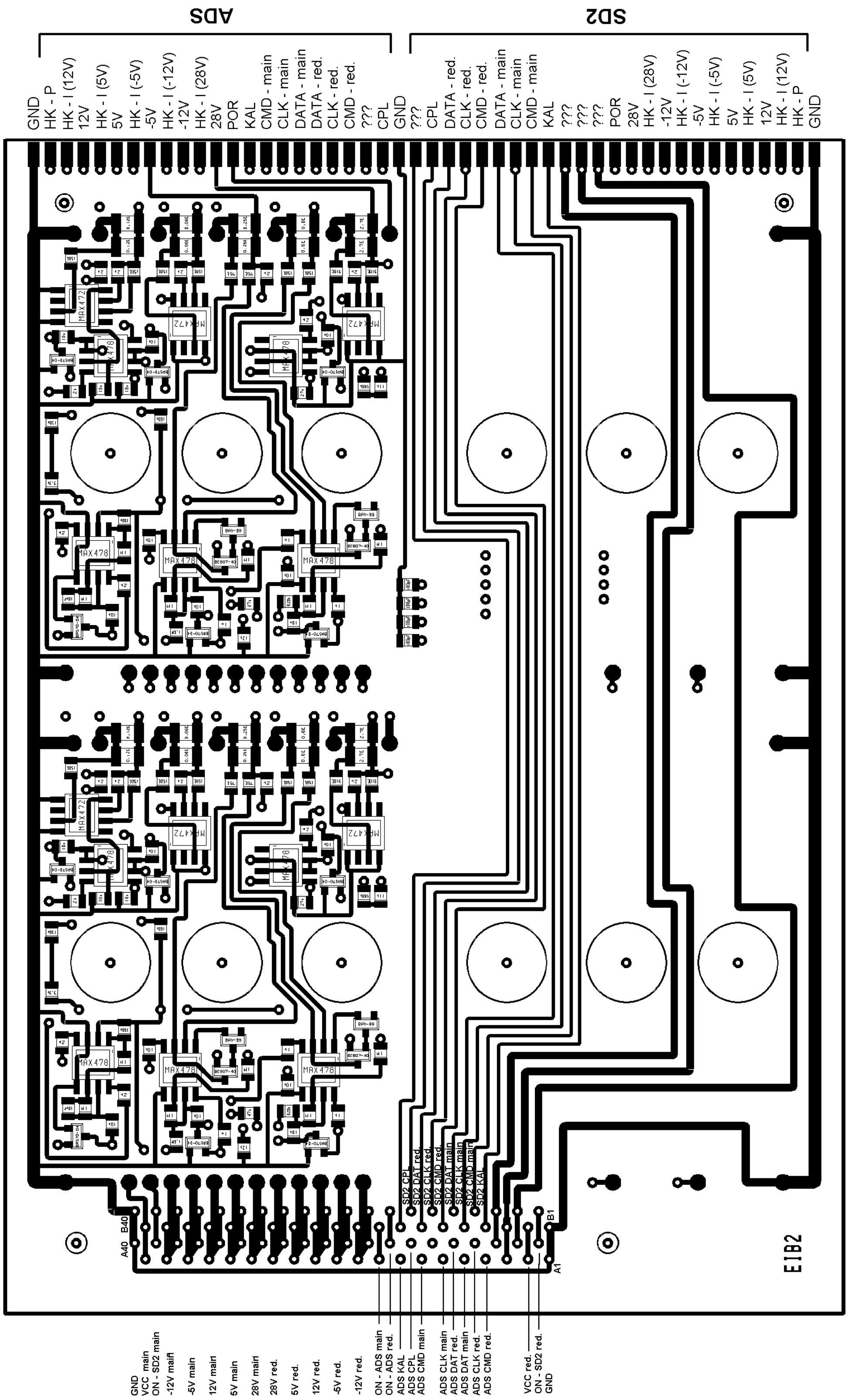


Figure 5-18 layout of dual interface board for ADS and SD2

This board contains two complete interface circuits and two soft – switch-on circuits.

Housekeeping Requirements

Current and Power measurement from I/F board has the following standard values.
(values can be changed upon request)

Housekeeping	Equivalent output
+5V	+1V ≙ 0.5A
+12V	+1V ≙ 0.25A
+18.5V (ÇIVA only)	+1V ≙ 0,25A
+28V	+1V ≙ 25mA
-5V	+1V ≙ 50mA
-12V	+1V ≙ 50mA
POWER	+1V ≙ 4W

Table 5-3 current measurement output

The maximum values of the housekeeping outputs which will be generated can reach +4 Volts. The housekeeping outputs have to be added to experiment or subsystem housekeeping data.

5.3.2 Connector and Harness Definition

The interconnection between the two Electronic boxes will be connected with a rigid-to-flex PCB and MALCO MCEM1-128 connectors.

5.3.2.1 Connectors used

connectors for experiment interface board: MALCO MCEM1-80PZ / MCEM1-80SRA
connectors for experiments or subsystems: MALCO MCEM1-40PZ / MCEM1-40SRA
connectors for experiments or subsystems: MALCO MCEM1-80PZ / MCEM1-80SRA
connectors for E-Boxes interconnection: MALCO MCEM1-128PZ / MCEM1-128SZ

5.3.2.2 Grounding concept (diagram)

The two E-Boxes will have a star point for grounding. The location of the star point is E-Box Y near PSS (see Fig. 5-11).

5.3.2.3 Shielding concept

First PCB (electronic Interface Board) of every experiment board stack is completely copperised and contacted to the E-Box housing.

Systems without I/F board have to shield their first PCB as well.

5.3.2.4 Safety plugs

A safety plug (red tag item) is connected via Power SS. This safety line is offered on the interface board contact name CPL (command protection line). It should be connected with a schottky diode to GND and with a 100k pull up resistor to +5V (see Fig. 5-19). Every experiment or subsystem which wishes to have a connection to this line to prevent switch-on of high voltage, deployment, cover release etc., should use this line and equip the necessary parts on their own electronic boards.

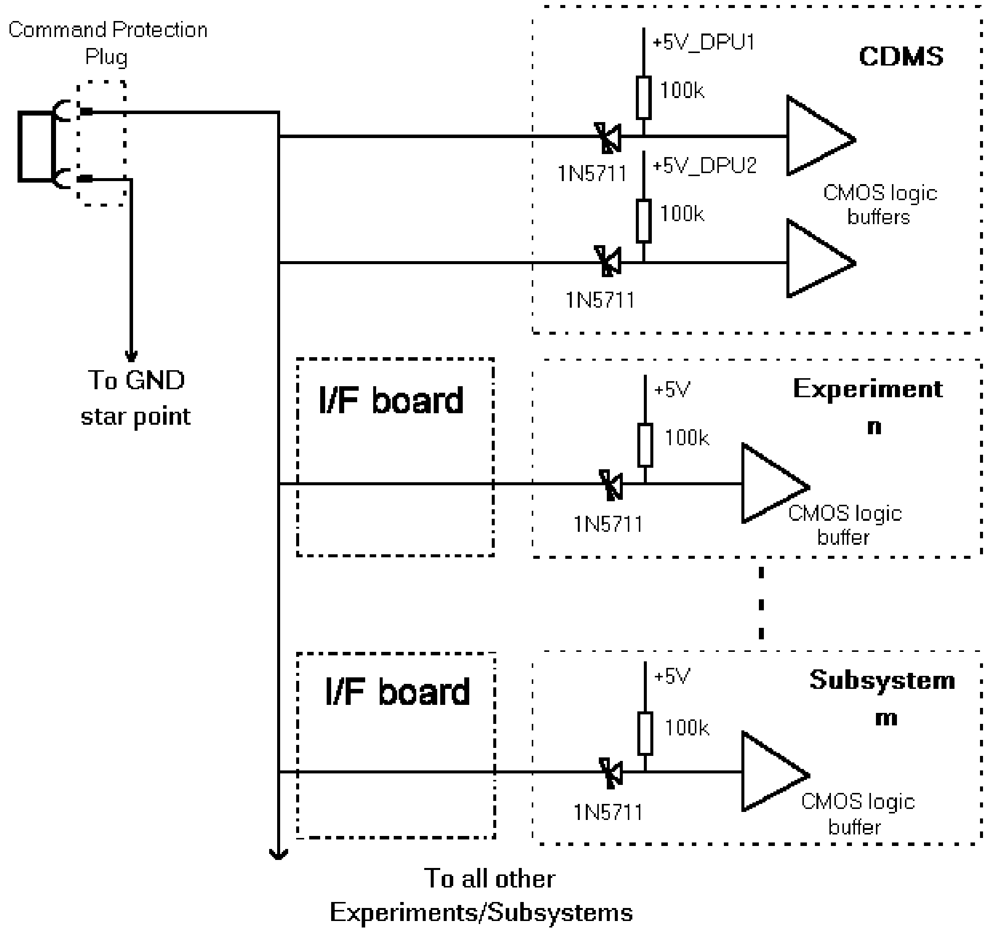


Figure 5-19 schematics for safety line

5.3.3 Cables

A rigid-to-flex PCB between the two electronic boxes is foreseen.

6 THERMAL DESIGN REQUIREMENTS

6.1 Rosetta Lander Thermal Control

The Thermal Control System (TCS) of the Rosetta Lander will provide an internal temperature environment throughout all mission phases. Relevant phases for the TCS are the launch and hibernation phase, when the Lander will be attached inactively to the Rosetta Orbiter, the check-out and pre-separation phase, when the Lander will be attached to the Orbiter and in an operational mode, and the descent and comet surface phases, when the Lander will be autonomous and mostly in active mode.

Due to the large distance from the Sun at the beginning of the surface operations limited power will be available for Lander operation. Therefore thermal control is achieved by means of passive thermal control techniques. The design of the TCS includes: accommodation of subsystem and experiment units on an “warm“ internal structure forming the internal compartment high performance conductive insulation of the internal compartment from cold Lander structure by low conductive webs and stand-offs, high performance radiative insulation from cold Lander structure by a two step multi layer insulation (MLI) directly mounted between internal compartment and outer shell (i.e. solar hood and baseplate), inner structure, MLI, and component surfaces shall have a high emissivity ($\varepsilon > 0.8$) to increase radiative exchanges, hence decreasing thermal gradients, separate MLI housing for battery stack, limited budget for heat leaks caused by tubes and harness between internal compartment and cold outside units.

In spite of all these precautions, the average temperature in the compartment during a comet day at 3 AU distance to the Sun will only be above the lower limit requested by payload and subsystem units, when additional power will be dissipated in the compartment. In order to reduce the demand for electrical power dissipation an additional precaution is introduced: direct usage of solar radiation via a thermal absorber unit to heat up the warm compartment during stand-alone phases at far distances from Sun. When approaching the Sun, the absorbed solar power will increase and the compartment temperature will exceed the upper temperature limit. The TCS is designed to allow on surface operations until 2 AU heliocentric distances.

The thermal capacity of the components accommodated to the warm compartment is large enough to store thermal energy gathered during the illuminated period of a comet day to maintain the temperature requirements also during the night period.

Nevertheless the TCS needs, in addition to the solar absorber, at far distances to the Sun, to be supported by:
a Thermal Control Unit (TCU) operating heaters and temperature sensors used during the phases when the Lander is operational, a heater and thermostat set used during hibernation, when the Lander is attached to the Orbiter a heater set used for wake-up, when the Lander in long nights during surface phases cools down below the switch-on temperatures a set of thermistors, read-out by the Orbiter OBDH as long the Lander is attached to the Orbiter and whenever the Orbiter OBDH is operating.

Payload and subsystem units mounted to the cold outside area of the Lander (i.e. balcony, solar hood, external baseplate and landing gear) need to survive the extreme conditions. No specific precautions are foreseen. If they become necessary, they have to be defined and implemented by the providers of the payload and subsystem units.

6.2 Payload Thermal Control

The experiment shall be designed to withstand the extreme temperatures which may be experienced during transportation, testing, launch and flight.

The Lander Thermal Control Subsystem shall control the interface of all payload units with the

heat exchange requirements
interface temperature specifications
interface thermal model.

From the thermal control point of view, the units fall in two categories:
Individually controlled (IC) units, for units conductiveley and radiatively decoupled from the Lander and performing their own thermal control
Collectively controlled (CC) units, for units conductively and radiatively coupled from the Lander and thermally controlled by the Lander TCS.

As a baseline all payload units accommodated in the internal compartment and surrounded by the internal MLI tent belong to the collectively controlled category. All other units belong to the individually controlled category.

6.2.1 Individually controlled units

The thermal design of these units shall be under the responsibility of the experimenter, controlled by defined interfaces between the unit and the Lander.

Experimenters Responsibilities

The conductive insulation needed between the unit and the Lander shall be sized, procured and implemented by the experimenter. The radiative insulation needed by the unit shall be defined, procured and implemented by the experimenter. The Interface Thermal Mathematical Model shall be provided by the experimenter for verification. The internal thermal design shall be the responsibility of the experimenter. To satisfy the unit individual thermal control requirement, the experimenter may decide to use internal operational heaters. This heater power required shall be budgeted within the experimenter power resource allocated.
Due to limited power especially during hibernation and 3 AU non-operating phases on the comet as a baseline no power for non-operational experiment thermal control will be available.
The design shall be verified by analysis and test. Analysis shall verify that all parts are within the specified temperature range in extreme worst case.

Lander Responsibilities

The heat exchange requirement and the interface temperature specification shall be defined by the Lander thermal control.
The Lander shall verify through various analytical cases that the thermal design of the unit satisfies the unit requirements. It shall also be verified that the conductive heat exchanges between the unit and the Lander does not alter adversely the performance of the Lander thermal subsystem. In case of difficulties, the Lander may impose a requirement on the conductive heat fluxes.

The following data shall be given by the Lander:

Results of each thermal analysis loop in terms of:

- I/F conductive temperature
- Incident (but not absorbed) solar flux per external node
- Incident (but not absorbed) I/R flux per external node (T sink eventually)
- Nodal temperatures
- Conductive heat flow budget and eventually conductive requirement
- Assessment of the results in terms of performances e.g. assessment of the problems associated to radiatve areas, assessment of the non Op procedures.

6.2.2 Collectively controlled units

Those units will be controlled by the Lander Thermal Control Subsystem, but their internal thermal design shall be under the responsibility of the experimenter.

Experimenters Responsibilities

The internal thermal design is the responsibility of the experimenter, he shall provide adequate information about unit internal design and the internal requested temperature.

Lander Responsibilities

The interface thermal design shall be defined by the Lander Thermal Control to adjust the conductive and radiative unit interface. The Lander TCS shall provide the corresponding hardware (including heater).
The Lander thermal subsystem will monitor the temperature of the internal compartment and will ensure that it stays within the agreed range.
The design shall be verified by analysis and test. Analysis shall verify that all parts are within the specified temperature range for the extreme worst cases.

6.3 Environmental Conditions

6.3.1 Launch, Cruise, Comet Rendezvous and Orbiting phases

For environmental conditions during these phases see Rosetta EID-A, section 2.3.3.

6.3.2 Orbiter thermal characteristics

The Orbiter thermal characteristics are specified in the Rosetta EID-A, section 2.3.3.4 and in a technical note presenting preliminary results regarding the thermal interface environment RO-DSS-TN-1014.

6.3.3 Comet environmental characteristics

The comet environmental characteristics are specified in the ”46P / Wirtanen Nucleus reference Model” and its updates (Ref.: ROL-DLR/Möh-TN 001/96, RO-ESC-RP-5006, May 1999).

6.3.4 Lander thermal characteristics

Preliminary thermal mathematical analysis has been performed. In order to fulfil the requirements on the TCS the following characteristics of the thermal hardware have been identified:

Unit	Coating	Thermo optical Properties	
		α	ε
solar hood walls	Solar array (loaded) Solar array (unloaded)	0.64 0.86	0.84 0.84
solar hood lid	Solar array (loaded) Solar array (unloaded)	0.64 0.86	0.84 0.84
Carrier frame	alodine	0.30	0.20
Balcony facing MLI	vda	0.14	0.05
Balcony	alodine	0.30	0.20
Baseplate	alodine	0.30	0.20
Balcony walls	Solar array (loaded) Solar array (unloaded) alodine	0.64 0.86 0.30	0.84 0.84 0.20
Thermal absorber	TINOX black paint	0.95 0.90	0.04 0.90
External MLI tent inner layer	vda	0.14	0.05
Internal MLI tent outer layer	vda	0.14	0.05
Internal MLI tent inner layer	black kapton	0.96	0.78

Table 6-1 Lander thermal characteristics (Subsystems)

6.4 Thermal Interfaces Requirements

Those interfaces shall be defined in the Thermal Interface Control Drawing and summarised in the Interface Control Thermal Mathematical Model.

6.4.1 Conductive Interface

The mounting interface shall comply with the mechanical and EMC requirements. The instrument platform is conductively isolated from the cold structure using low conductive stand-offs and webs.

The internally accommodated payload units shall be well coupled by conduction to the instrument platform, mounting areas shall not be painted or anodised.
To achieve the desired internal unit temperature for experiments which are mounted outside the internal compartment, the provider may apply conductive isolation (see also chapter 4.2.1).

The amount of interconnections between components inside and outside the warm compartment should be limited to achieve low conductive heat exchange. Due to low electrical dissipation and/or heater power the heat exchange budget is restricted.

6.4.2 Radiative Interface

The heat exchange requirements of section 4.5 and the desired internal unit temperature shall be achieved by the selection of finishes.

Individually controlled (IC) units:
The recommended coatings for the external surfaces are:
- multi layer insulation (MLI), black Kapton on the outside
- vacuum deposited aluminium (vda)
- gold-plated or alodine.

Collectively controlled (CC) units:
They shall be designed with an emissivity > 0.8, the final trimming shall be performed by the Lander Thermal Control.

6.4.3 Heater Power

During hibernation phases the Lander will be provided with 15 W heater power from the Orbiter. The distribution and control will be accomplished by the Lander TCS. Special heater power for the individual controlled experiments is not available during the hibernation periods of the cruise phase.

The following figure shows the actual foreseen hibernation heater circuitry.

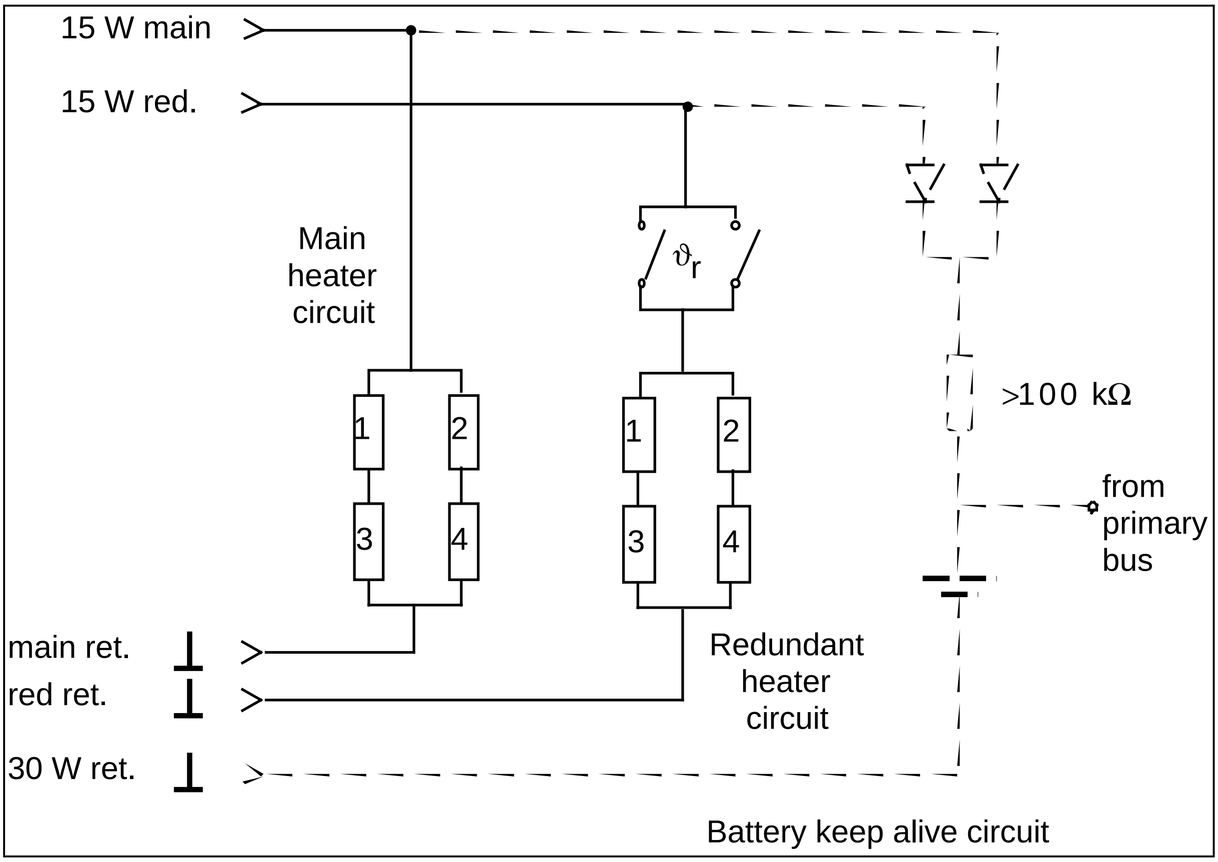


Figure 6-1 Hibernation heater circuitry

The temperature of the internal compartment will be maintained during hibernation by direct electrical heating. During the operational phases the dissipation of the operating internal system and/or experiment units is used to maintain the temperature requirements in the compartment. If necessary the temperature control will be supported by electrical heating.
In case of too low temperature conditions (i.e. during a comet night), the available electrical power will be used to adjust the compartment's temperature instead of operating external experiments.

For collectively controlled units it is envisaged to attach heater foils directly to surfaces of the boxes.

6.4.4 Temperature monitoring

Lander powered temperature sensors will be used to monitor the internal compartments temperature environment. Their number and location is TBD. The sensors will also be used to control the Lander powered heaters.

Monitoring of external system and experiments will be provided case by case.

The Lander provided temperature sensors will consist of PT1000 elements used in a two-wire technique. It is envisaged to achieve ± 2K accuracy in the temperature range of -60°C to +80°C. In the ranges below -60°C and above +80°C an accuracy of ±5K is envisaged.

In addition, temperature monitoring of selected points within an experiment shall be provided by the Experimenter and embedded in the experiment housekeeping data.

The following table summarises the actual (TBC) foreseen temperature monitoring:

Experiment		in Lander H/K data	in Orbiter H/K data
ÇIVA	-P	2 sensors	1 sensor
	-M	1 sensor	-
ROLIS	-D	-	-
MUPUS	-PEN	1 sensor	-
	-TM	1 sensor	-
ROMAP (on magnetometer board in sensor)		1 sensor	-
CONSERT (TRP on mounting foot of E-box)		1 sensor	-
PTOLEMY (E-box)		1 sensor	-
COSAC		-	-
APX		-	-
SESAME		-	-

Table 6-2 Temperature sensors (TBC)

6.4.5 Thermal hardware

See RO-EST-RS-3002/EID A.

6.5 Design Requirements and Control Budgets

The experiments shall be designed to comply with the Lander interfaces and their own units requirements in term of temperature and heat exchange. The design will be supported by analyses, which will predict the nominal worse case and extreme worst case temperatures.

6.5.1 Interface temperature budget

The Thermal Control System TCS guarantees for the individual units temperature ranges for operating and non-operating mode. These ranges are kept at the Temperature Reference Point TRP (e.g. on a mounting foot of the unit). On the other side, the unit is requested to keep the agreed dissipation and heat fluxes within ranges to be agreed in the REID-B.
The following table gives the global TRP ranges for internal and external units.

	Ops	Non-ops
Internal (compartment)	-40°C to +50°C	-55°C to +70°C
External (balcony)	-140°C to –50°C	-150°C to ± 0°C

Table 6-3 TRP Temperature Range

6.5.2 Heat Exchange Requirement and Budget

The second parameter defining the thermal interface is given by the heat flux. The heat exchange budget defines the amount of heat that can be transferred (conductively and radiatively) between the experiment unit and the Lander.

Collectively Controlled (CC) Units

The heat exchange depends on the power dissipation in the CC units. A detailed power - time profile should be provided by the investigator.

Individually Controlled (IC) Units

As baseline the IC units shall be conductively and radiatively decoupled from the Lander. The heat exchange must be restricted by unit design and mounting interface to TBD watts. A detailed power - time profile should be provided by the investigator.

The conductive heat exchange applies at the interface between the unit and the Lander. It includes the conductive heat through the harness and, if applicable, through the piping.

The agreed heat exchange budget have to be defined in each relevant REID-B.

6.6 Documents Requirements List

The Experimenter shall provide the following documents:

- Thermal interface drawing
- Description (in verbal and tabular form) of relevant Interface Thermal Mathematical Model (template see below).
- Test and Flight temperature prediction report (incl. description of mathematical model employed), if available.

6.7 Interface Thermal Mathematical Model

The purpose of this Interface Thermal Mathematical Model (ITMM) is to represent the external thermal interface of the payload unit to the Lander and to other units mounted on the Lander. These models are incorporated at system level in order to generate the complete Lander. The system model is subjected to analyses and test during different Project phases, and the results of this will be feedback into the refinement of interface parameters and unit thermal design if needed. The interface model shall concentrate on the correct representation of the external thermal interfaces, i.e. each separate unit (e.g. main box, sensor unit, boards in the common E-box, etc.) should be represented in the ITMM (refer to Fig. 6-2).

One node shall be used to represent the mounting feet and the mounting surface of the unit. The outer surface of an external MLI shall be modelled separately from the structure underneath. The number of internal nodes shall be minimised. The Lander TCS will calculate the radiative exchange of the outer surfaces to the environment.

During the first iteration own node numbers might be used. To avoid any repetition in the numbering during the assembly of the different geometrical and thermal models, the range of node numbers per unit will be defined and specified in the next update of the REID-A. As a reference it is recommended to limit the node numbers per separate unit to:

3 nodes	for C/C units
10 nodes	For I/C units.

In addition to the following tables the investigator should provide also a rough sketch of the unit geometry and nodal breakdown, in order to allow the Lander TCS to build up a repesentative Interface Thermal Mathematical Model.
For explanation of the requested parameter refer to the **Notes and Explanations** following the tables. For additional reference see RO-EST-RS-3001/EID C.

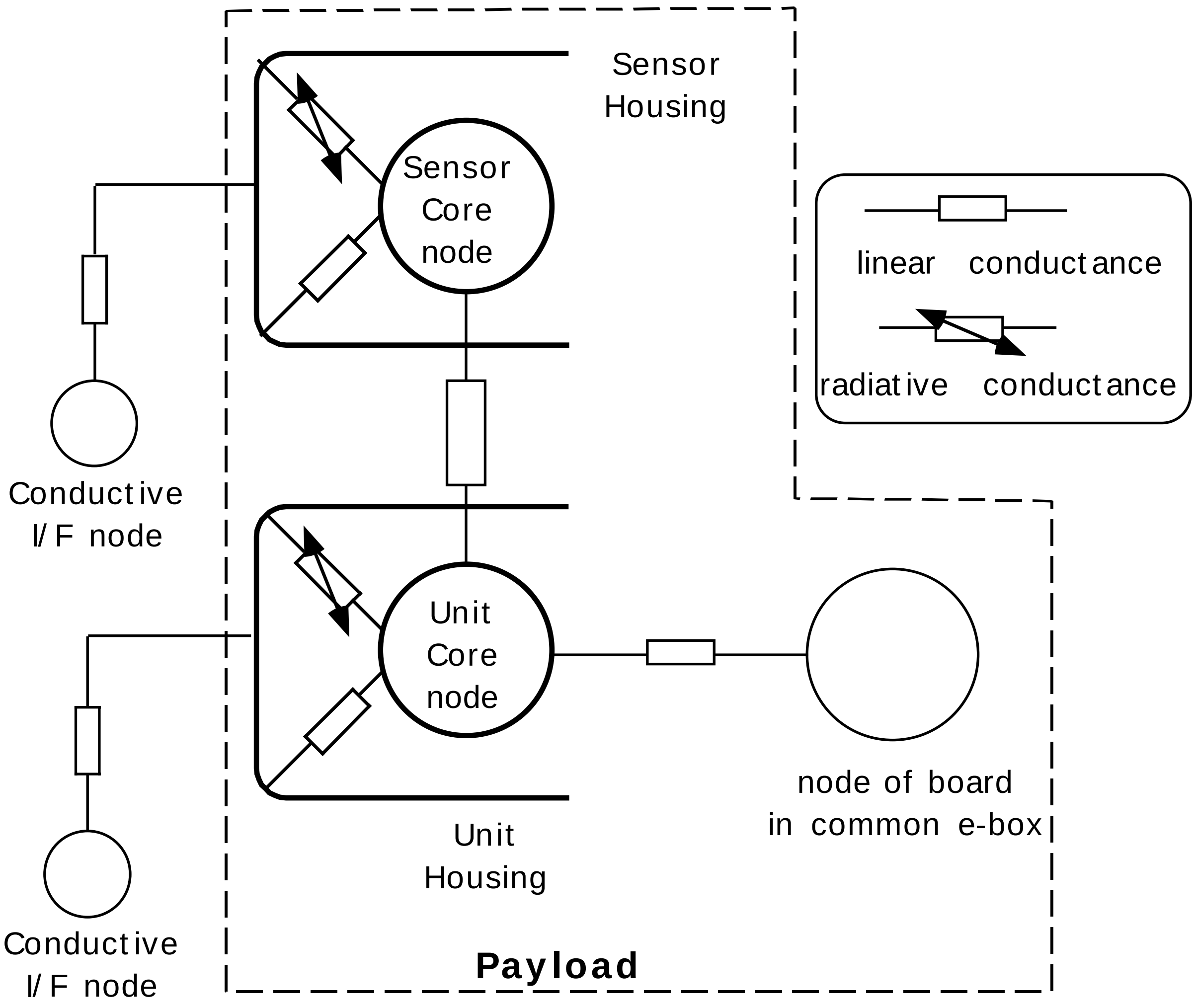


Figure 6-2 Schematics of the nodal breakdown for a payload consisting of three separate units: main, sensor and board-assembly in the common E-box.

Surface Properties

Node	Name	Material	Thermal Finish	α_s	ρ_s^d	ρ_s^s	ε_h	ρ_h^d	ρ_h^s
(1)	(2)	(3)	(4)	(5)	(6)	(6)	(8)	(8)	(8)

Table 6-4 BOL Surface Properties

Node	Name	Material	Thermal Finish	α_s	ρ_s^d	ρ_s^s	ε_h	ρ_h^d	ρ_h^s
(1)	(2)	(3)	(4)	(5)	(6)	(6)	(7)	(8)	(8)

Table 6-5 EOL Surface Properties

Note:

τ_s and τ_h, the transmittances for solar and infrared wavelengths respectively are derived from the following expressions:

$\alpha_s + \rho^d_s + \rho^s_s = 1 - \tau_s$ for the solar wavelengths

$\varepsilon_h + \rho^d_h + \rho^s_h = 1 - \tau_h$ for the infrared wavelengths

Node Properties

Node	Name	Material	A (m^2)	mCp (J/K)	Non-Op. Heater	TRP location	At av.(%) trim.
(1)	(2)	(3)	(9)	(10)	(11)	(11)	(12)

Table 6-6 Node Properties (C/C units)

Node	Name	Material	A (m^2)	mCp (J/K)	Non-Op. Heater	TRP location	Op. Heater
(1)	(2)	(3)	(9)	(10)	(11)	(11)	(20)

Table 6-7 Node Properties (I/C units)

Design Temperature Ranges

Node	Op. (°C)	Non-Op. (°C)	Op. Stab. (°C/h)
(13)	(14)	(15)	(16)

Table 6-8 Design Temperature Ranges

Power Dissipations

		BOL		EOL	
Mode	Node	Op. QI (W)	Non-Op. QR (W)	Op. QI (W)	Non-Op. QR (W)
(17)	(18)	(19)	(20)	(19)	(20)

Table 6-9 Power Dissipations (C/C units)

This table shall give at least the minimum and maximum electrical and associated non-operational heater dissipations for all modes and/or mission time.

		Op (34)					Non-op (35)				
Mode (17)	Node (18)	QI	QS	QA (W)	QE	QR	QI	QS	QA (W)	QE	QR

Table 6-10 BOL Power Dissipations (I/C units)

		Op (34)					Non-op (35)				
Mode (17)	Node (18)	QI	QS	QA (W)	QE	QR	QI	QS	QA (W)	QE	QR

Table 6-11 EOL Power Dissipations (I/C units)

Note:

These tables shall contain the extreme cases in terms of power dissipations among all the possible modes of operation. The dissipations variables shall be assigned positive values if received, negative if lost by the unit node. They shall be used as follows:

- QI: electronic dissipations
- QR: heater power
- QS, QA, QE: environmental heat fluxes.

QS, QA, QE contain the solar, albedo and planet/comet environmental heat fluxes absorbed by the surfaces of the model. They will be calculated with the overall Lander geometrical mathematical model.

Couplings

Node i	Node j	GL (W/K)
		(21)

Table 6-12 Internal Conductive Couplings

Node i	Node j	GR (m^2)
		(22)

Table 6-13 Internal Radiative Couplings

Type	Number	Ac (cm^2)	Node	Conductive I/F Node
(23)	(24)	(25)	(26)	(27)

Table 6-14 Interface (mounting) Conductance

Type	Number	λ (W/(m*K))	Ac (m^2)	l (m)	Node i	Node j
(28)	(29)	(30)	(31)	(32)	(33)	(33)

Table 6-15 Harness / Piping Conductance

Notes and Explanations:

(1) The node number represents either an external or an internal part of the unit. An external node is directly associated with a surface or a combination of surfaces which shall appear in the unit model sketch.

(2) The name indicates unambiguously the hardware associated to the node. It shall mention each external node facing direction w.r.t. the Lander reference coordinate system and **not the URF**.

(3) The unit material associated to the node e.g. Al6061, MLI, stainless steel ...

(4) Gives not only the aspect of the surface thermal finish but also a detailed description of the thermal finish, terms of aspect, manufacturer and composition. The composition shall describe the different constituents from the inner to the outermost layer.

(5) α_s Absorptance for the solar wavelengths (0.2 μm < λ < 2.8 μm). As a start BOL and EOL thermo-optical properties have to be given. This value is not required if the surface is not exposed to the environmental heat fluxes (in particular solar) at any time of the mission.

(6) ρ^d_s , ρ^s_s Reflectance for the solar wavelengths (0.2 μm < λ < 2.8 μm). Part of it is diffuse (d), the remaining part is specular (s). These values are not required if the surface is not exposed to the environmental heat fluxes (in particular solar) at any time of the mission.

(7) ε_h Hemispherical emittance at infrared wavelenghts (5 μm < λ < 50 μm).

(8) ρ^d_h , ρ^s_h Reflectance for the infrared wavelengths (5 μm < λ < 50 μm). Part of it is diffuse (d), the remaining part is specular (s).

(9) A Area of an external node. It must be equal to the area of a surface or a combination of surfaces as depicted in the unit model sketch.

(10) mC_p Thermal capacity of the node. For computational stability reasons of the Lander model, MLI nodes shall be assigned small values.

(11) Indicates a possible location for a Lander non-operational heater (HT). The Lander powered temperature sensor (TS) is located at the TRP.

(12) At Area available (av.) for trimming to be provided by the unit supplier and area actually trimmed (trim.) by the Lander TCS. Both are given in % of the total surface area. The trimming consists in applying a VDA tape (low emittance ε_h) on the unit (TBC).

(13) Node number.

(14) Operational design temperatures range of the TRP. The Lander TCS shall be designed against these temperatures including suitable modelling uncertainty margins based on sensitivity analyses made by the Lander TCS.

(15) Non-operational design temperature range at the TRP. The Lander TCS is also responsible to maintain the TRP within the specified temperature range.

(16) Temperature stability when the unit is operational.

(17) Mode of operation of the unit.

(18) Node number to which the dissipation is applied.

(19) When operating, this is the electrical dissipation.

(20) When non-operating, the unit electrical dissipation is replaced by a non-operational heater dissipation (TBC). QR is the required heater dissipation at 28 V (TBC) to maintain the unit with the non-operational temperature range specified in the table for TRP design temperature ranges. R is the heater resistance. QR and R are both calculated by the Lander TCS as result of the system thermal analyses (TBC).

(21) Linear conductance (GL) between two internal nodes.

(22) Radiative coupling ($GR = \varepsilon_i A_i B_{ij}$) between two internal nodes. B_{ij} is the Gebhart factor.

(23) Type of mounting e.g. foot, flush button ...

(24) Number of mountings or mounting number.

(25) Total interface contact area **in cm^2**. It is written as „Number * Area per Foot" for foot mounted units. It is the contact area for flush bottom units. The size of the bolts used to attach the unit onto the Lander shall also be provided.

(26) Interface node on the unit side.

(27) Conductive interface Lander node.

(28) Type of conductor, e.g. harness, pipe, ...

(29) Number of single conductors, e.e. wires, pipes,...

(30) Conductivity of single conductor

(31) Cross section of single conductor

(32) Length of single conductor

(33) Conductor connecting $Node_i$ and $Node_j$

(34) Operational power dissipation and losses. QR is the operational heater power estimated by the unit provider to maintain the node at a constant temperature. The Lander TCS will recalculate the required heater power and compare it also to the available heater power.

(35) Non-operational power dissipation and losses. QR is the non-operational heater power estimated by the unit provider to maintain the node at the TRP within the non-operational range as specified (Table 6-3 or (15)) . The Lander TCS will recalculate the required heater power and compare it also to the available heater power at 28 V (TBC).

7 EMC DESIGN REQUIREMENTS

7.1 Lander Lander Grounding Concept

The Lander baseline is to have common signal and power ground and a star ground system. For details see Fig. 7-1. In order to ensure proper data communication between CDMS and the connected instruments, the Lander instruments shall implement one of the grounding/power supply schemes proposed on the right hand side of the schematic in Fig. 7-1.

7.2 Lander EMC Requirements

- electrical isolation
- case and cable shielding
- emission and susceptibility (radiated and conducted)

shall be performed according to EID-A Sect. 2.9.

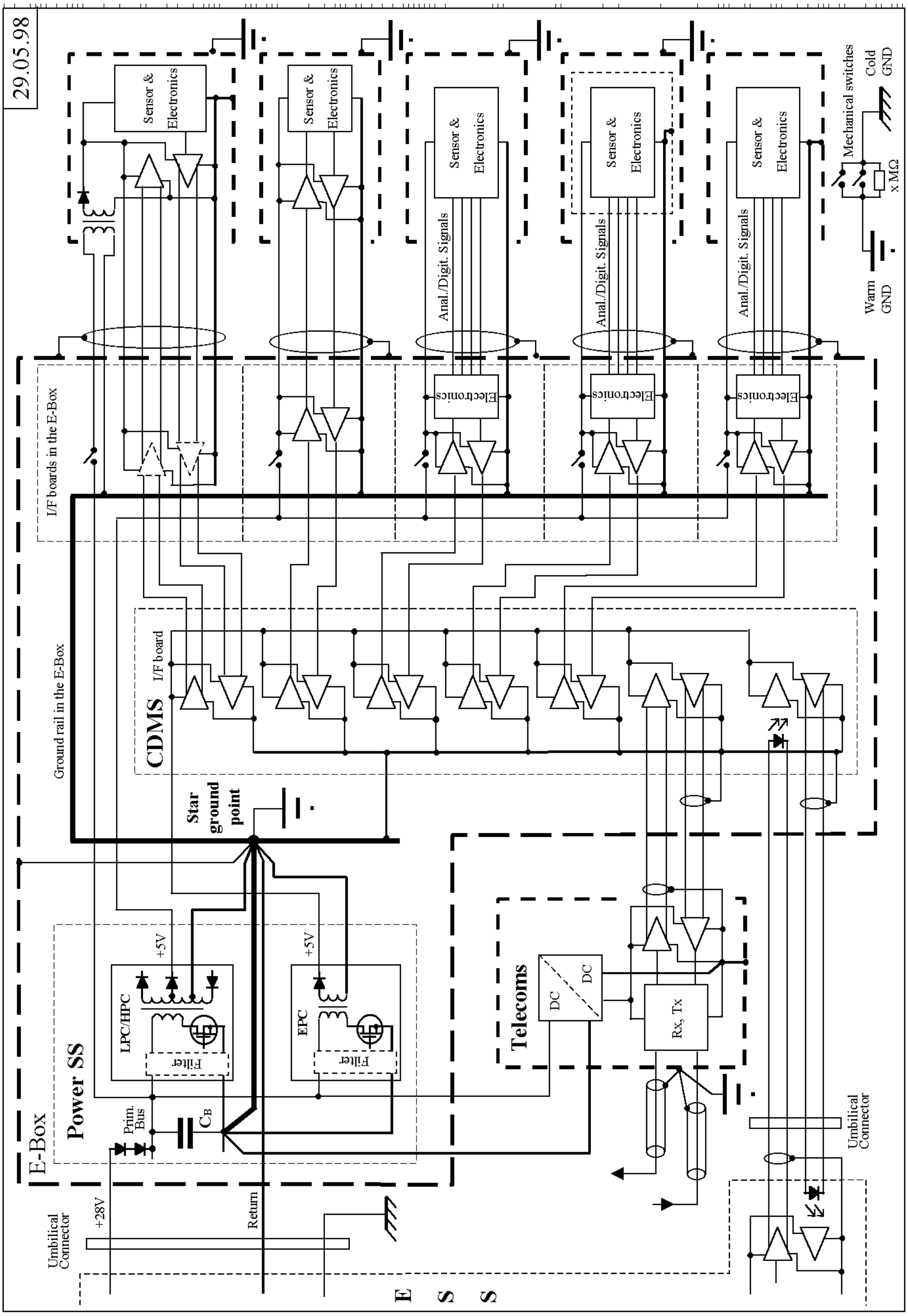


Figure 7-1 Lander Grounding Concept

8 EXPERIMENT DESIGN VERIFICATION REQUIREMENTS

The following section should aid the Team Member in complying with the Interface Requirements and will give design levels, durations and analytical methods for qualification tests as well as adapted values for flight certification (flight acceptance).

8.1 Sequence and Assembly

A general test matrix (Table 8-1) is given below as a template.

Test-Description	STM		DM	EQM		FM	
	SSP	SSP-S/C	SSP	SSP	SSP-S/C	SSP	SSP-S/C
Mech. Interface		R, T			R, T		T
Mass Property	T					T	
Electr. Perform.				T	T	T	T
Functional Test	T*1)		Sim,T*2)	T *4)	T *5,6)	T_A	T_A
Separation Test	A	A, T	Sim			T_A	T**
Telecom. Link				A,T	T*7)	A,T	T
Strength Load	A, T_Q	A, T_Q				T_A	
Shock	T_Q	T_Q*3)				T_A	
Sine Vibration	A, T_Q	A, T_Q	T_D			T_A	T_A
Low Level Sine	A, T_Q	A, T_Q	T_D			T_A	T_A
Random Vibration	T_Q	T_Q	T_D			T_A	
Acoustic noise	T_Q	T_Q				T_A	T_A
Outgasing							
Thermal balance	A, T_Q	A,$T_{Q,Cruise}$				T_A	$T_{A, Cruise}$
Thermal vacuum	T_Q	T_Q		T_Q*8)		T_A	T_A
Grounding/Bond.	R, T_V	R, T_V		R, T	R, T	R, T_V	R, T_V
EMC cond. interf.				T_V	T_V	T_V	T_V
EMC rad. interf.				T_V	T_V	T_V	T_V
DC magnetic				T_V	T_V	T_V	T_V
Purging rate				I		I	

*1) = TCU, APX, MUPUS as far as testable on Lander level
*2) = Tests of Landing Scenario (Landing Gear, Anchor, Flywheel, ADS) applying µg-simulation
*3) = if applicable (use of pyro nuts TBC)
*4) = Lander SW verification and operational function tests
*5) = ESS SW verification, Orbiter I/F verification
*6) = CONSERT RF functional verification
*7) = End-to-End link test (Tx/Rx, CONSERT)
*8) = only integrated E-Box and Solar Hood

SSP: Lander Level
S/C : Orbiter Level

A : Analysis
I : Inspection
R : Review of design

S : Similarity
Sim : Simulation

T_Q : Test at qualification level
T_A : Test at acceptance level
T_D : Development Tests
T_v : Verification by Measurement

Table 8-1 TEMPLATE Verification Matrix (taken from VPP)

A detailed test plan shall be attached with the respective REID-Bs.
Generally all units have to be tested mechanically, thermally (thermal vacuum), as well as their electrical and functinal behaviour (if applicable).
For more detailed informations, consult the Rosetta Lander Verification Program Plan (VPP), RO-LAN-PL-3301 (Issue: Basic, Rev. 0, 25/09/98).

8.2 Electrical Functional Performance Test Requirements

A series of tests and analyses should be conducted to verify the instruments electrical behaviour in particular that of the interface circuitry.

As a minimum required the following characteristics should be demonstrated:

- power supply, i.e. inrush-, peak-, steady state current and isolation resistance, including keep alive line
- Telecommand signals
- data (and clock) signals
- special signals (if applicable)

Functional verification tests should prove safe and reliable performance of hard- and software in all operational modes, including redundant circuitry, within allowable limits. They will have to be performed before, during (e.g. TV) and after all environmental tests, although an abbreviated version may suffice.

8.3 Structural and Mechanical Verification Requirements

8.3.1 General

The Experiment design verification shall be performed using the classical methods developed for this purpose, i.e., verification of equipment design by

- analysis
- testing
- similarity providing a design already qualified exists.

This section specifies the mechanical analysis and test requirements for the experiment qualification and acceptance. Specific test levels and duration and analytical methods for implementing the requirements are described.
The following documentation shall also be consulted for analysis and test planning, performance, evaluation, and documentation:
Sections 2.3 and 8.1 of this document describing the design requirements and test sequence and assembly

- RO-EST-RS-3001/EID A, Vol. 4, describing in detail the test procedures, test set up, and test facility requirements.
- RO-EST-RS-3001/EID C, Part C, describing in detail the requirement specification for payload unit interface structural mathematical models.

The experiment verification shall be supported by **Analysis Reports**, **test procedures** and completed by **test reports**.

All units must be qualified with a dedicated qualification model (QM) with Q-levels prior to FM. The QM must be almost identical w.r.t. all aspects (mechanically, electrically, etc.) to the FM that will be delivered. The QM is only aimed to qualify the unit, it is in principle not mounted on the Lander afterwards. Upon special request the ROSETTA Lander Project Office may agree in some cases to allow the QM to be used as FM.
Consult the EID-A for functional test to be performed before and after vibration tests.
Consult the EID-A for mechanism qualification requirements

8.3.2 Structural Requirements

A series of structural analyses and tests shall be conducted to verify the design of the hardware, specified factors of safety, interface compatibility, workmanship, and compliance with associated launch authority safety requirements.
The analysis shall be performed as part of the design process and to verify the adequacy of the design to cover dispersion in the characteristics of the materials and the assembly. Consult Sec. 2.3 for design guidelines.
For the lander S/S and P/L units the following tests are mandatory to qualify the design:
1. Strength Test
The unit shall undergo a (quasi) static test to demonstrate the capability of the design (particularly of the interfaces) to withstand quasi-static loads. The acceleration loads are defined in Sec.8.3.4. This test can either be performed on a centrifuge or on a shaker at a low frequency (ref. EID-A Vol. 4).
2. Dynamic Test
The unit shall be tested to demonstrate that the minimum frequency requirements are met (ref. Sec. 2.3) and that the unit can withstand the specified low frequency mechanical environment.
3. Random Vibration Test
The unit shall be subjected to a random vibration test to demonstrate its ability to survive the random environment arising during pre-launch and launch environments. This type of test is usually the most severe for a correctly designed unit and the one most likely to induce failures in the electronic circuitry.
4. Shock test
The unit shall be subjected to a shock test to demonstrate its ability to survive mechanical shock stresses arising during pre-launch, launch and in orbit environments.
5. Acoustic Vibration test
In general units having high frequency sensitive parts or large surfaces exposed to space shall be subjected to an acoustic vibration test to demonstrate its ability to survive mechanical stresses arising during pre-launch and launch environments.
The mechanical tests 2 and 3 are usually performed on a shaker along all three axes in sequence. Limited Functional Tests shall be carried out between axes to verify that the unit performance has not been degraded.

8.3.3 Structural Mathematical Model

An interface structural mathematical model (ISMM) is required for **all** units. Depending on the complexity of the unit, the ISMM can be a simple mass model, a physical finite element model or a reduced finite element model. The experimenter shall consult the EID-C to determine which type of model shall be delivered.
As described in the EID-C, for simple boxes with low masses (< 1 kg effective modal mass up to 140 Hz) and/or high eigenfrequencies (> 140 Hz), the ISMM consists simply of the mass, mass moments of inertia and center of mass of the unit.

The ISMM shall be verified by test and updated accordingly. In case of finite element models this validation can be done by a specific modal survey test or a low level sine test whichever is practical.

8.3.4 Test Levels

The strength load (quasi-static), sinusoidal vibration, random vibration, and acoustic test levels were derived from the ROSETTA Lander STM test results. In the following these levels are defined for the payload and subsystems on the Lander. For test levels for units that are not listed the ROSETTA Lander Structure Team shall be contacted.
The random test levels given below should cover the acoustic loads seen by the components.
Shock test levels are taken from the EID-A.

8.3.4.1 Strength load, sine vibration, random vibration, and acoustic vibration levels

Units on the Instrument Platform

Y-E-Box

Table 8-2 Quasi-static test loads for Y-E-Box

Direction	Level
All	40 g

Table 8-3 Sine vibration qualification and acceptance level for Y-E-Box

Direction	Frequency [Hz]	Qualification Level		Acceptance Level	
		Acceleration Level [g]	Sweep Rate [oct/min]	Acceleration Level [g]	Sweep Rate [oct/min]
x	0 - 100	18	2	12	4
y, z	0 - 100	31	2	21	4

Table 8-4 Random vibration qualification and acceptance level for Y-E-Box

Direction	Frequency [Hz]	Qualification Level		Acceptance Level	
		Power spectrum	Duration [min/axes]	Power spectrum	Duration [min/axes]
x	20 - 100 100 - 300 300 - 2000	+3 dB/oct 0.27 g^2/Hz - 5 dB/oct	2.5	+3 dB/oct 0.12 g^2/Hz - 5 dB/oct	1
y,z	20 - 100 100 - 150 150 - 200 200 - 300 300 - 2000	+3 dB/oct 1.33 g^2/Hz * dB/oct 0.36 g^2/Hz - 5 dB/oct	2.5	+3 dB/oct 0.59 g^2/Hz * dB/oct 0.16 g^2/Hz - 5 dB/oct	1

* Log-log interpolation.

Z-E-Box

Table 8-5 Quasi-static test loads for Z-E-Box

Direction	Level
All	43 g

Table 8-6 Sine vibration qualification and acceptance level for Z-E-Box

Direction	Frequency [Hz]	Qualification Level		Acceptance Level	
		Acceleration Level [g]	Sweep Rate [oct/min]	Acceleration Level [g]	Sweep Rate [oct/min]
x	0 - 100	16	2	11	4
y, z	0 - 100	36	2	24	4

Table 8-7 Random vibration qualification and acceptance level for Z-E-Box

Direction	Frequency [Hz]	Qualification Level		Acceptance Level	
		Power spectrum	Duration [min/axes]	Power spectrum	Duration [min/axes]
x	20 - 100 100 - 150 150 - 200 200 - 300 300 - 2000	+3 dB/oct 0.24 g^2/Hz * dB/oct 0.12 g^2/Hz - 5 dB/oct	2.5	+3 dB/oct 0.11 g^2/Hz * dB/oct 0.06 g^2/Hz - 5 dB/oct	1
y,z	20 - 100 100 - 150 150 - 200 200 - 300 300 - 2000	+3 dB/oct 2.66 g^2/Hz * dB/oct 0.36 g^2/Hz - 5 dB/oct	2.5	+3 dB/oct 1.18 g^2/Hz * dB/oct 0.16 g^2/Hz - 5 dB/oct	1

* Log-log interpolation.

Units on the Large Auxiliary Plate

All COSAC Units and Ptolemy

The values given in the tables below are for the configuration of these units as tested during the STM test. For design changes in the units the levels may have to be updated.

Table 8-8 Quasi-static test loads for units on large auxiliary plate

Direction	Level
All	41 g*

- 44 g for COSAC MS-E-Box
-

Table 8-9 Sine vibration qualification and acceptance levels for units on large aux. plate

Direction	Frequency [Hz]	Qualification Level		Acceptance Level	
		Acceleration Level [g]	Sweep Rate [oct/min]	Acceleration Level [g]	Sweep Rate [oct/min]
x, z (lateral)	0 - 100	28	2	19	4
y (normal)	0 - 100	31 (36)*	2	21 (24)*	4

- Value in () is for COSAC He

Table 8-10 Random vibration qualification and acceptance levels for units on large aux. plate

Direction	Frequency [Hz]	Qualification Level		Acceptance Level	
		Power spectrum	Duration [min/axes]	Power spectrum	Duration [min/axes]
x, z (lateral)	20 - 100 100 - 150 150 - 200 200 - 300 300 - 2000	+3 dB/oct 1.01 g^2/Hz * dB/oct 0.29 g^2/Hz - 5 dB/oct	2.5	+3 dB/oct 0.45 g^2/Hz * dB/oct 0.13 g^2/Hz - 5 dB/oct	1
y (normal)	20 - 100 100 - 150 150 - 200 200 - 300 300 - 2000	+3 dB/oct 6.05 g^2/Hz * dB/oct 0.85 g^2/Hz - 5 dB/oct	2.5	+3 dB/oct 2.69 g^2/Hz * dB/oct 0.38 g^2/Hz - 5 dB/oct	1

* Log-log interpolation.

COSAC and Ptolemy levels shall be confirmed when the final design of these units is known.

Units on the Small Auxiliary Plate

SD2-E-Box

Table 8-11 Quasi-static test loads for SD2-E-Box

Direction	Level
All	40 g

Table 8-12 Sine vibration qualification and acceptance levels for SD2-E-Box

Direction	Frequency [Hz]	Qualification Level		Acceptance Level	
		Acceleration Level [g]	Sweep Rate [oct/min]	Acceleration Level [g]	Sweep Rate [oct/min]
x, z (lateral)	0 - 100	26	2	17	4
y (normal)	0 - 100	34	2	23	4

Table 8-13 Random vibration qualification and acceptance levels for SD2-E-Box

Direction	Frequency [Hz]	Qualification Level		Acceptance Level	
		Power spectrum	Duration [min/axes]	Power spectrum	Duration [min/axes]
x, z (lateral)	20 - 100 100 - 300 300 - 2000	+3 dB/oct 0.73 g^2/Hz - 5 dB/oct	2.5	+3 dB/oct 0.33 g^2/Hz - 5 dB/oct	1
y (normal)	20 - 100 100 - 150 150 - 200 200 - 300 300 - 2000	+3 dB/oct 4.24 g^2/Hz * dB/oct 0.24 g^2/Hz - 5 dB/oct	2.5	+3 dB/oct 1.88 g^2/Hz * dB/oct 0.11 g^2/Hz - 5 dB/oct	1

* Log-log interpolation.

All other units

For all other units on the small auxiliary plate the same levels as for the SD2-E-Box shall be used as test loads.

Units on the Front Plate

Consert

Table 8-14 Quasi-static test loads for Consert

Direction	Level
All	40 g

Table 8-15 Sine vibration qualification and acceptance levels Consert

Direction	Frequency [Hz]	Qualification Level		Acceptance Level	
		Acceleration Level [g]	Sweep Rate [oct/min]	Acceleration Level [g]	Sweep Rate [oct/min]
x(normal)	0 - 100	19	2	13	4
y, z (lateral)	0 - 100	30	2	20	4

Table 8-16 Random vibration qualification and acceptance levels for Consert

Direction	Frequency [Hz]	Qualification Level		Acceptance Level	
		Power spectrum	Duration [min/axes]	Power spectrum	Duration [min/axes]
x (normal)	20 - 100 100 - 150 150 - 200 200 - 300 300 - 2000	+3 dB/oct 0.54 g^2/Hz * dB/oct 0.36 g^2/Hz - 5 dB/oct	2.5	+3 dB/oct 0.24 g^2/Hz * dB/oct 0.16 g^2/Hz - 5 dB/oct	1
y, z (lateral)	20 - 100 100 - 150 150 - 200 200 - 300 300 - 2000	+3 dB/oct 2.42 g^2/Hz * dB/oct 0.36 g^2/Hz - 5 dB/oct	2.5	+3 dB/oct 1.08 g^2/Hz * dB/oct 0.16 g^2/Hz - 5 dB/oct	1

* Log-log interpolation.

Units on the Top Plate

Flywheel

Table 8-17 Quasi-static test loads for Flywheel

Direction	Level
All	44 g

Table 8-18 Sine vibration qualification and acceptance levels for Flywheel

Direction	Frequency [Hz]	Qualification Level		Acceptance Level	
		Acceleration Level [g]	Sweep Rate [oct/min]	Acceleration Level [g]	Sweep Rate [oct/min]
x, y (lateral)	0 - 100	36	2	24	4
z (normal)	0 - 100	36	2	24	4

Table 8-19 Random vibration qualification and acceptance levels for Flywheel

Direction	Frequency [Hz]	Qualification Level		Acceptance Level	
		Power spectrum	Duration [min/axes]	Power spectrum	Duration [min/axes]
x, y (lateral)	20 - 100 100 - 150 150 - 200 200 - 300 300 - 2000	+3 dB/oct 6.05 g^2/Hz * dB/oct 0.61 g^2/Hz - 5 dB/oct	2.5	+3 dB/oct 2.69 g^2/Hz * dB/oct 0.27 g^2/Hz - 5 dB/oct	1
z (normal)	20 - 100 100 - 150 150 - 200 200 - 300 300 - 2000	+3 dB/oct 3.63 g^2/Hz * dB/oct 0.12 g^2/Hz - 5 dB/oct	2.5	+3 dB/oct 1.61 g^2/Hz * dB/oct 0.06 g^2/Hz - 5 dB/oct	1

* Log-log interpolation.

SD2-Connector Plate

For this unit no reliable data is available. Use the Flywheel data for the tests.

Units on the Balcony and the Support Truss

MUPUS/APX and ROMAP

Table 8-20 Quasi-static test loads for MUPUS/APX and ROMAP

Direction	Level
All	37 g

Table 8-21 Sine vibration qual. and acceptance levels for MUPUS/APX and ROMAP

Direction	Frequency [Hz]	Qualification Level		Acceptance Level	
		Acceleration Level [g]	Sweep Rate [oct/min]	Acceleration Level [g]	Sweep Rate [oct/min]
All	0 - 100	18	2	12	4

Table 8-22 Random vibration qual. and acceptance levels for MUPUS/APX and ROMAP

Direction	Frequency [Hz]	Qualification Level		Acceptance Level	
		Power spectrum	Duration [min/axes]	Power spectrum	Duration [min/axes]
x, y	20 - 100 100 - 150 150 - 200 200 - 300 300 - 2000	+3 dB/oct 0.61 g^2/Hz * dB/oct 0.37 g^2/Hz - 5 dB/oct	2.5	+3 dB/oct 0.27 g^2/Hz * dB/oct 0.17 g^2/Hz - 5 dB/oct	1
z	20 - 100 100 - 150 150 - 200 200 - 300 300 - 2000	+3 dB/oct 1.21 g^2/Hz * dB/oct 0.49 g^2/Hz - 5 dB/oct	2.5	+3 dB/oct 0.54 g^2/Hz * dB/oct 0.22 g^2/Hz - 5 dB/oct	1

- Log-log interpolation.

SD2

Table 8-23 Quasi-static test loads for SD2

Direction	Level
All	40 g

Table 8-24 Sine vibration qualification and acceptance levels for SD2

Direction	Frequency [Hz]	Qualification Level		Acceptance Level	
		Acceleration Level [g]	Sweep Rate [oct/min]	Acceleration Level [g]	Sweep Rate [oct/min]
x, y (lateral)	0 - 100	17	2	12	4
z (normal)	0 - 100	17	2	12	4

Table 8-25 Random vibration qualification and acceptance levels for SD2

Direction	Frequency [Hz]	Qualification Level		Acceptance Level	
		Power spectrum	Duration [min/axes]	Power spectrum	Duration [min/axes]
x, y (lateral)	20 - 100 100 - 150 150 - 200 200 - 300 300 - 2000	+3 dB/oct 3.60 g^2/Hz * dB/oct 0.43 g^2/Hz - 5 dB/oct	2.5	+3 dB/oct 1.60 g^2/Hz * dB/oct 0.19 g^2/Hz - 5 dB/oct	1
z (normal)	20 - 300 300 - 500 500 - 2000	+3 dB/oct 0.58 g^2/Hz - 5 dB/oct	2.5	+3 dB/oct 0.26 g^2/Hz - 5 dB/oct	1

- Log-log interpolation.

EJECT and ROLIS

Table 8-26 Quasi-static test loads for EJECT and ROLIS

Direction	Level
All	30 g

Table 8-27 Sine vibration qualification and acceptance levels for EJECT and ROLIS

Direction	Frequency [Hz]	Qualification Level		Acceptance Level	
		Acceleration Level [g]	Sweep Rate [oct/min]	Acceleration Level [g]	Sweep Rate [oct/min]
x, y (lateral)	0 - 100	17	2	12	4
z (normal)	0 - 100	17	2	12	4

Table 8-28 Random vibration qualification and acceptance levels for EJECT and ROLIS

Direction	Frequency [Hz]	Qualification Level		Acceptance Level	
		Power spectrum	Duration [min/axes]	Power spectrum	Duration [min/axes]
x, y (lateral)	20 - 100 100 - 300 300 - 2000	+3 dB/oct 0.49 g^2/Hz - 5 dB/oct	2.5	+3 dB/oct 0.22 g^2/Hz - 5 dB/oct	1
z (normal)	20 - 100 100 - 300 300 - 2000	+3 dB/oct 0.36 g^2/Hz - 5 dB/oct	2.5	+3 dB/oct 0.16 g^2/Hz - 5 dB/oct	1

* Log-log interpolation.

ÇIVA Stereo Camera

Table 8-29 Quasi-static test loads for ÇIVA Stereo Camera

Direction	Level
All	41 g

Table 8-30 Sine vibration qualification and acceptance levels for ÇIVA Stereo Camera

Direction	Frequency [Hz]	Qualification Level		Acceptance Level	
		Acceleration Level [g]	Sweep Rate [oct/min]	Acceleration Level [g]	Sweep Rate [oct/min]
x, y	0 - 100	19	2	13	4
z	0 - 100	19	2	13	4

Table 8-31 Random vibration qualification and acceptance levels for ÇIVA Stereo Camera

Direction	Frequency [Hz]	Qualification Level		Acceptance Level	
		Power spectrum	Duration [min/axes]	Power spectrum	Duration [min/axes]
x, y	20 - 100 100 - 300 300 - 2000	+3 dB/oct 0.49 g^2/Hz - 5 dB/oct	2.5	+3 dB/oct 0.22 g^2/Hz - 5 dB/oct	1
z	20 - 80 80 - 150 150 - 200 200 - 300 300 - 2000	+3 dB/oct 2.66 g^2/Hz * dB/oct 1.82 g^2/Hz - 5 dB/oct	2.5	+3 dB/oct 1.18 g^2/Hz * dB/oct 0.81 g^2/Hz - 5 dB/oct	1

* Log-log interpolation.

8.3.4.2 Shock

The purpose of this test is to verify that the units can withstand the shocks induced by release mechanisms, latching shocks at the end of deployments, release of the lander, and shocks related to pyro firing.
The Experiment units shall be compatible with the following shock response spectrum (SRS) levels to be applied in each direction of the three orthogonal axes:
The characteristic of the shock is a transient shock wave with uncorrelated excitation w.r.t. unit I/F location and time as defined in Table 1.

Table 8-32 Qualification Shock Levels (TBC)

Axis	Frequency (Hz)	Shock response Spectra (Q=10) Qualification levels
X,Y,Z	100	25
X,Y,Z	100 - 1500	rising slope
X,Y,Z	1500	2000
X,Y,Z	1500 - 10000	2000

The transient wave characteristic with the required SRS can be simulated on a ringing plate (shock table). In case of a ringing plate, the required SRS shall be achieved on the test plate close (<40mm) to the unit bolt I/F.

8.4 Electromagnetic Compatibility Requirements

See EID-A, sect. 2.9.

8.5 Thermal Vacuum Verifications

A series of thermal analyses and tests shall be conducted to verify the design of the hardware.

The analysis will be performed as part of the design process and to verify the adequacy of the design to cover dispersion in the characteristics of the materials and the exchanges.

A Thermal Balance Test is not required on unit level, as a thermal balance test was already executed on Lander level with the Lander STM.

Experiment and subsystem units shall be subject to a thermal vacuum test in order to demonstrate that they can satisfactorily operate in mission operating temperatures; at temperatures in excess of the predicted mission range, and during temperature transitions.

The thermal vacuum test criteria shall cover the design loads and the applicable margins to compensate for uncertainties in the thermal parameters and to provide stress conditions that would not otherwise be uncovered prior to flight.

The thermal vacuum test at unit level shall be performed as defined in Fig. 8-1

The temperatures are defined at the temperature reference points specified in the following tables 8-46, 8-47:

	Ops	Non-Ops
Units in compartment below internal MLI	-50°C / +60°C	-65°C / +80°C
Units below solar hood (i.e. ÇIVA camera heads)	-100°C / +10°C	-110°C / +20°C
External units (on balcony)	-150°C / -40°C	-160°C / +10°C

Table 8-33 Qualification test temperature range

	Ops	Non-Ops
Units in compartment below internal MLI	-40°C / +50°C	-55°C / +70°C
Units below solar hood (i.e. ÇIVA camera heads)	-90°C / +0°C	-100°C / +10°C
External units (on balcony)	-140°C / -50°C	-150°C / +0°C

Table 8-34 Acceptance test temperature range

The temperature tolerance shall be at:

max Temperature $^{+3}_{-0}$ deg C

min Temperature $^{+0}_{-3}$ deg C

Cycling between temperature extremes verifies performance under other than conditions of equilibrium and causes temperature gradient changes which induce stresses and reveal incipient problems.

Minimum number of cycle between temperature extremes:

- Qualification test: 6
- Acceptance test: 2

Temperature excursions during cycling of experiments shall be rapid enough to latent defects in workmanship. During the cycling, the unit shall be operating and be monitored.

For units within the compartment the rate of change shall be • 5°C/min.
For units outside the compartment the rate of change shall be • 20°C/min.

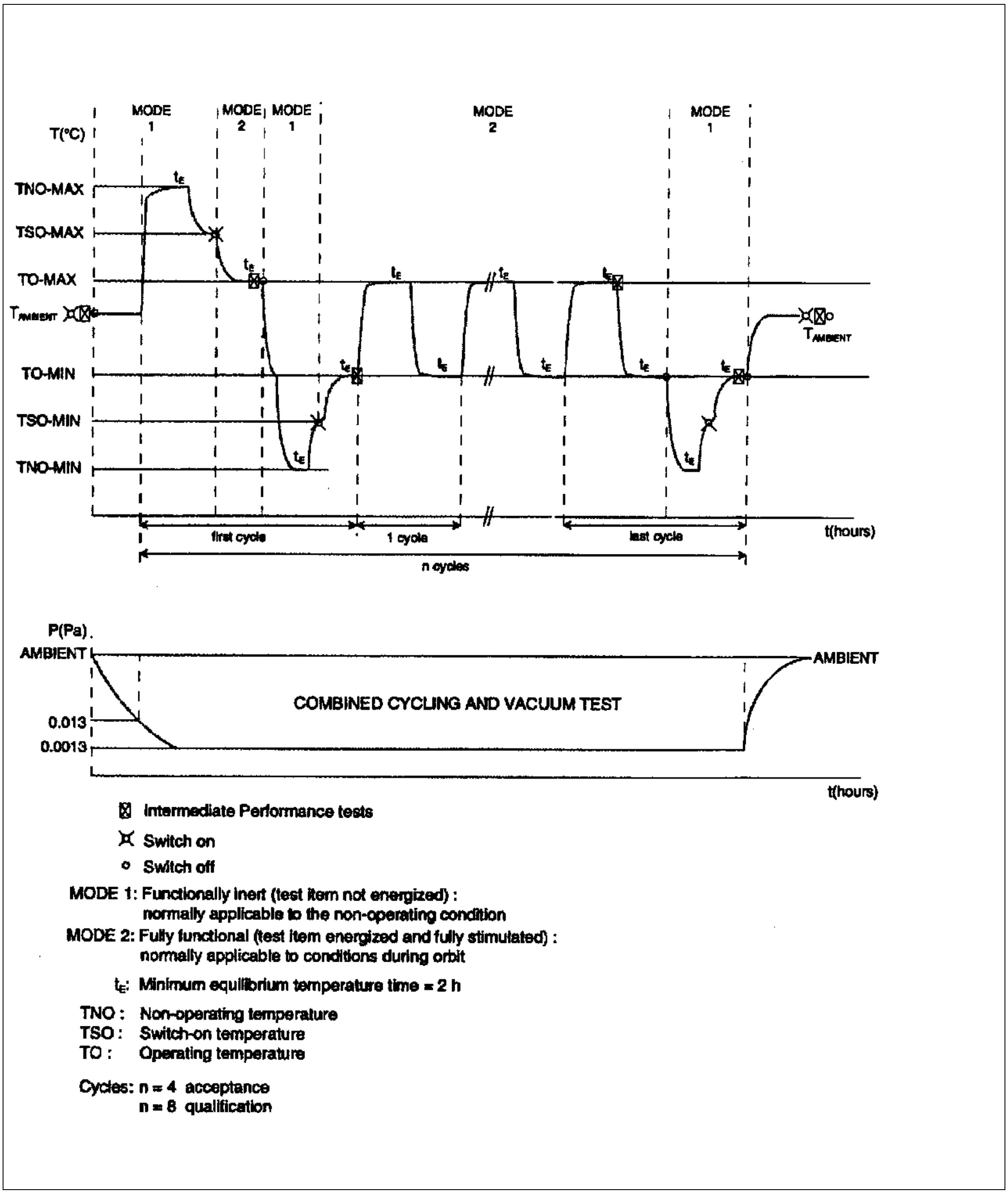


Figure 8-1 Thermal Vacuum Test Sequence

Temperature stabilisation shall be based on the temperature at the temperature reference point. Time at test temperature shall be counted from stabilisation. Within the demands of cost effectiveness, specific temperatures shall be forced at location by modifying the operational modes of the experiment and by adjusting local thermal boundary conditions using additional heating or cooling.

Temperature stabilisation shall be reached when the temperature rate of change at the temperature reference point is less than 5°C during a time period of 1 hour.

The vacuum during test performance shall be $\leq 10^{-3}$ Pa.

The total test duration shall be sufficient to verify performance and uncover early failures. The duration varies with such factors as the number of mission-critical operating modes, the test item thermal inertia, and test facility characteristics. Because of the length of time involved, it may be impracticable to conduct a Full Functional Test programme during thermal-vacuum testing. A limited Functional Test may be substituted providing satisfactory performance is demonstrated for the major mission-critical modes of operation.

Experiments shall be exposed at each extreme of each temperature cycle after temperature stabilisation to 4 hours.

The test configuration, including any external stimulation, shall be reviewed to ensure that the test objectives will be achieved.

The test item shall be, as nearly as practicable, in the configuration expected during flight operations.

The chamber shall be capable of creating representative gradients if required.

Internally mounted and equipment shall be bolted on a mounting black panel.

Externally mounted and protruding equipment will have a special setup to achieved the required temperatures and environment. It shall be defined in the test procedure and agreed with the Lander Project.

Temperature sensors (i.e. in general thermocouples) shall be attached to the unit in sufficient number and at such locations necessary to determine the highest and lowest temperature. They shall be defined in the test procedure and agreed with the Lander Project.

One redundant thermocouple shall be attached at the unit Thermal Reference Point and use as unit temperature monitor.

8.6 Acceptance of the Experiment and Associated Test Equipment

8.6.1 REID-B

Each experiment has to be accompanied with it’s respective REID-B

8.6.2 Unit Incoming inspection

An incoming inspection of each experiment delivered consists of the following:

- Check of documentation, ADP
- Visual inspection
- Dimensions

- Control and check of main physical/technical parameters
- Test of characteristic electrical data (Grounding/Bonding/Isolation)
- EMC Conducted Interference
- Function test if applicable and comparison to REID-B and payload specifications

8.6.3 Qualification, Acceptance, Test Facilities Requirements

See EID-A, Section 4.

9 GROUND SUPPORT EQUIPMENT

9.1 Electrical Ground Support Equipment

9.1.1 EGSE Concept

The Rosetta Lander EGSE software & hardware shall support :

Lander development
Scientific experiment test & integration
Lander integration
Lander simulation & mission operation

The EGSE shall provide full connectivity with the Lander and its subsystems, as well as with the integrated scientific experiments. For test & development additional interfaces to the Lander subsystems will be provided.

The EGSE is designed to support the electrical verification programme from the Lander unit level through to the system level including launch operations. It consists of an equipment to monitor and control test executions, analyse test results and control any stimuli equipment required to test the Lander.

The EGSE will be configurable for

electrical test on Lander unit level
electrical test on Rosetta system level
and flight operations

Depending on the operation requirements for different activities the EGSE interfaces will be adapted to provide standard services to the EGSE data processing front-end (DAVIS). As a result an unified user interface and data processing environment will be available for all the Lander ground preparation and mission activities.

The Lander investigators and authorised users may access archived data remotely through public networks.
The concept is based on the assumption that a Rosetta Orbiter OBDH interface simulator will be available for procurement. This simulator shall be able to provide the Lander data in a common network protocol standard (TCP/IP) the EGSE H/W.

9.1.2 Lander EGSE Requirements

The Lander-EGSE hardware has to be designed to support the different requirements of the various activities related to the Lander development and operation as described .

9.2 Unit level electrical tests

At unit level, all functions of the Lander including the Lander experiments need to be executed and tested and controlled by the EGSE. The Lander EGSE will support the unit electrical tests and the incoming inspection by:

- Control and sequence the electrical incoming inspection tests following a predefined procedure,
- Control the Interface Simulator set up and configuration before and during test,
- Process, analysis and display H/K and science data such that real time evaluation of the test progress and results can be performed,
- Support step by step testing and control of the Lander as well as trouble shooting
- Apply a filter on hazardous commands,
- Control any stimuli equipment required for tests (if applicable),
- Provide safe stimuli to the Lander (if applicable),
- Archive test results,
- Retrieve and compare archived data from previous bench tests.

9.3 System level electrical tests

At Rosetta system level, only a very reduced subset of Lander functions can be executed and tested, mainly generation of housekeeping data, maintenance functions, experiment calibration and subsystem and experiment conditioning.

The Lander EGSE will support the system electrical tests by:

- Process, analyse and display H/K and science data such that real time evaluation of the test progress and results can be performed,
- Distribution of real-time and archived data to display clients,

Generation of test sequences for CCS,

- Accept the requested telemetry and auxiliary information from the CCS in real time,
- Access the CCS archive to request telemetry and auxiliary data via messages sent via file transfer,
- Accept the requested data as files,
- Support both local and remote access to the CCS,
- Interface the CCS via local or wide area networks (TBD),
- Provide safe stimuli to the Lander (if applicable),
- Archive test results.

9.3.1 Interface Simulator Functions

See RO-EST-RS-3002/EID A

9.3.2 Central Checkout System

See RO-EST-RS-3002/EID A

9.3.3 Lander Input to the CCS

- Definition of Lander telecommands
- Definition of Lander housekeeping parameter
- Definition of Lander science and housekeeping TM packets
- Definition of Lander Telecommand packets
- Definition of system level test procedures for Lander testing at system level

9.3.4 Lander Stimuli Equipment

Lander stimuli equipment is TBD

9.3.5 Stimulation of Lander by On-board Sources

Requirements for stimulation of Lander by On-board sources are TBD (if any).

9.3.6 Lander EGSE Software

The ESGE shall manage the commands, standard housekeeping and scientific data as well as additional data and commands for test purposes. In addition commands to the Lander and the test equipment shall be checked, verified and logged. For simulation and mission operation a The Lander software simulator will be integrated into the software.

The EGSE shall consist of the following components :
standard information handling tool (DAVIS)
ROSETTA interface simulator
a dedicated Lander test interface (TBC)
Lander dedicated command processing
Lander simulation & planning tool

A major module of the EGSE is a standard real-time information data base system (DAVIS) provided by DLR-MUSC. The following data handling functionalities are incorporated into the DAVIS system :

- acquisition of data via TCP/IP from the Lander / CCS interface (mission control, test interface and/or ROSETTA interface simulator),
- storage of scientific experiment & housekeeping data (including pictures),
- logging of commanding,
- archiving,
- display & visualisation,
- evaluation,
- data base access & distribution via TCP/IP or higher level protocols,
- interface command tool.

The DAVIS software is realised in C, using the BAPAS data base system.

DAVIS will be enhanced with a dedicated Lander commanding software. This software shall :
- allow easy generation of Lander command sequences
- generate check and consistent commands for the Lander
- interface the DAVIS system for history tracking
- interface the simulation & planning tool for planning support and validation of commands during the mission.

The commanding tool will be developed using C and LabVIEW.

During simulation and mission a Lander simulator and planning tool will support planning and generation of command sequences, as well as keep track of the state of the Lander. An alternative link of the mission EGSE to the Lander ground reference model shall be implemented. Due to the data base capabilities of DAVIS information from preceding the Lander operation will be available for reference purposes.

DAVIS shall be identical for the development, test and operational configuration in order to provide a constant working environment for the PIs and test personnel.
In order to support the different tasks varying hardware components shall be available to interface the respective set-up.

The following set-ups are foreseen :

- Lander development,
- Lander experiment integration,
- Lander integration to Rosetta and system tests,
- Simulations,
- mission operations.

The DAVIS information system is an already functional system and will be proofed during various space missions. The application of the software to the Lander shall only require a configuration of DAVIS.

The operation of the EGSE software will be verified during test and simulation.

9.3.7 Lander EGSE Hardware

The EGSE hardware will be conform to the following requirements:

- All units will contain built-in power supplies such they can be operated from 220/240 or 110/120 V, 50 - 60 Hz mains supply,
- The EGSE will distribute mains power between its own units.
- EGSE power will be connected to chassis which in turn will be connected to ground by AC mains supply.
- EGSE will have protective covers over all hazardous parts.
- EGSE will designed to withstand the prevailing environmental conditions during usage, storage and transportation.

Three major EGSE hardware elements have been identified :

Data processing & control unit. A commercial state-of-the-art workstation for the data processing & archiving module. This unit will be identical for all different EGSE set-ups. The computer hardware & peripherals (hard disk, supporting computers, etc.) are TBD and will be fixed as late as possible.

ROSETTA Interface Simulator to be available for procurement. This simulator shall simulate all the Rosetta Lander ESS<-> ROSETTA S/C interfaces. The ROSETTA interface simulator (H/W & S/W) shall provide all Lander relevant ROSETTA communication interfaces by means of TCP/IP connections to the EGSE hardware.

- The Lander system interface adapter,
- Thermal control simulator,
- Power supply assembly,
- CDMS interface adapter,
- Umbilical interface adapter,
- Additional TBD analog and digital interfaces for test purposes.

A breakdown of the EGSE hardware elements is given below for the working environments to be considered:

The Lander development and subsystem/experiment in different integration phases:

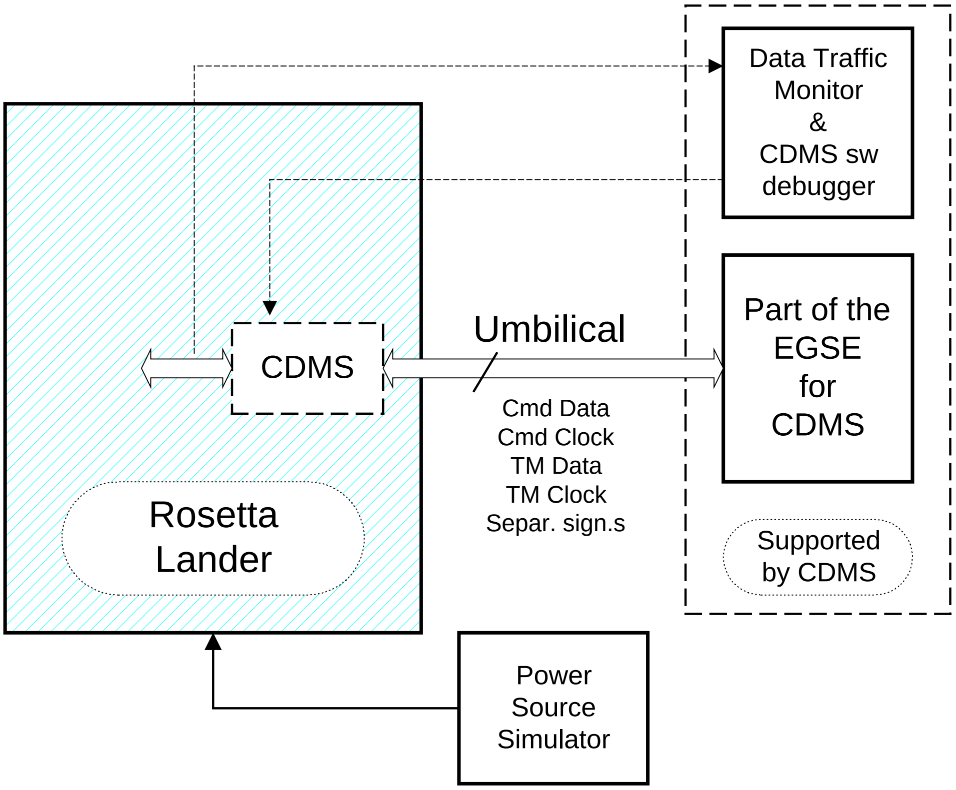


Figure 9-1 Lander Interfacing for breadboard tests via CDMS

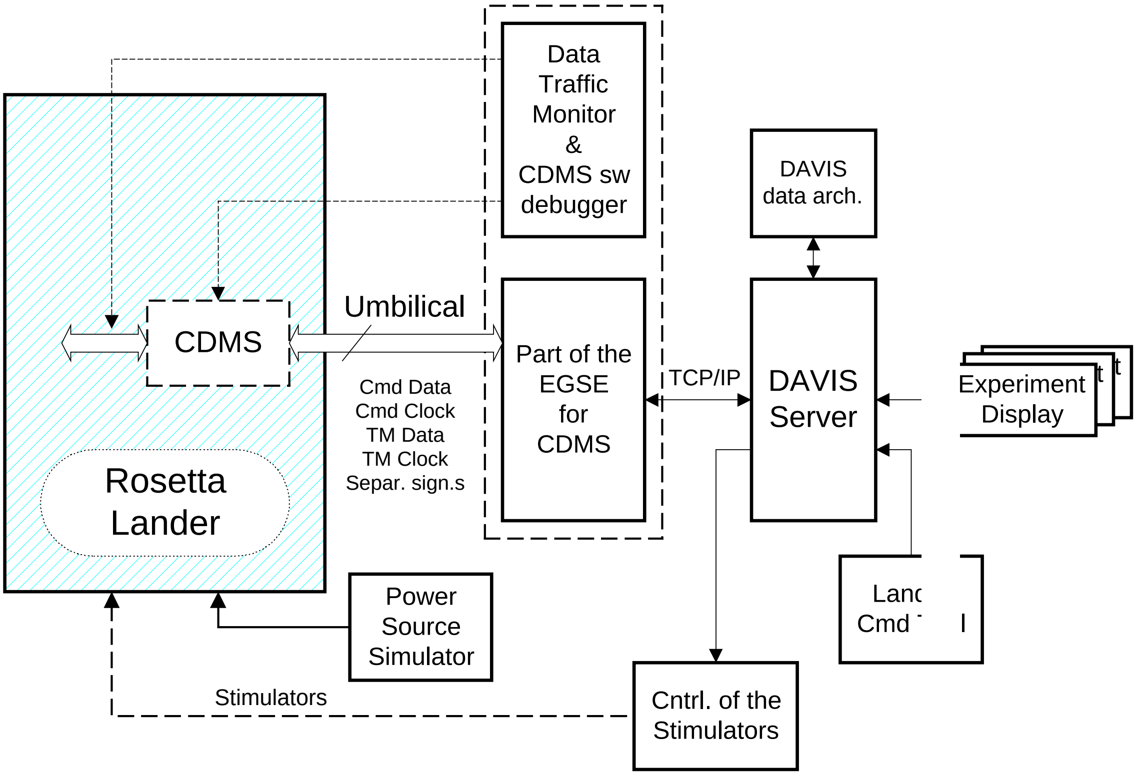


Figure 9-2 Application of Lander EGSE for Lander integration

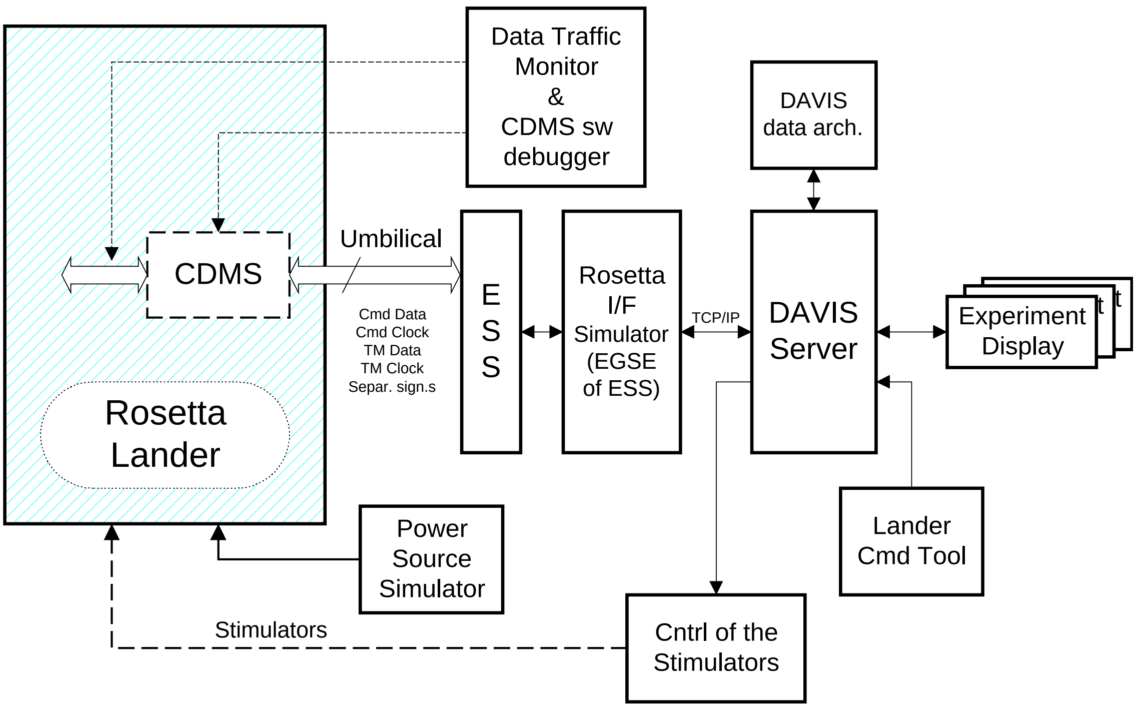


Figure 9-3 Application of EGSE for integrated Lander Test and Verification

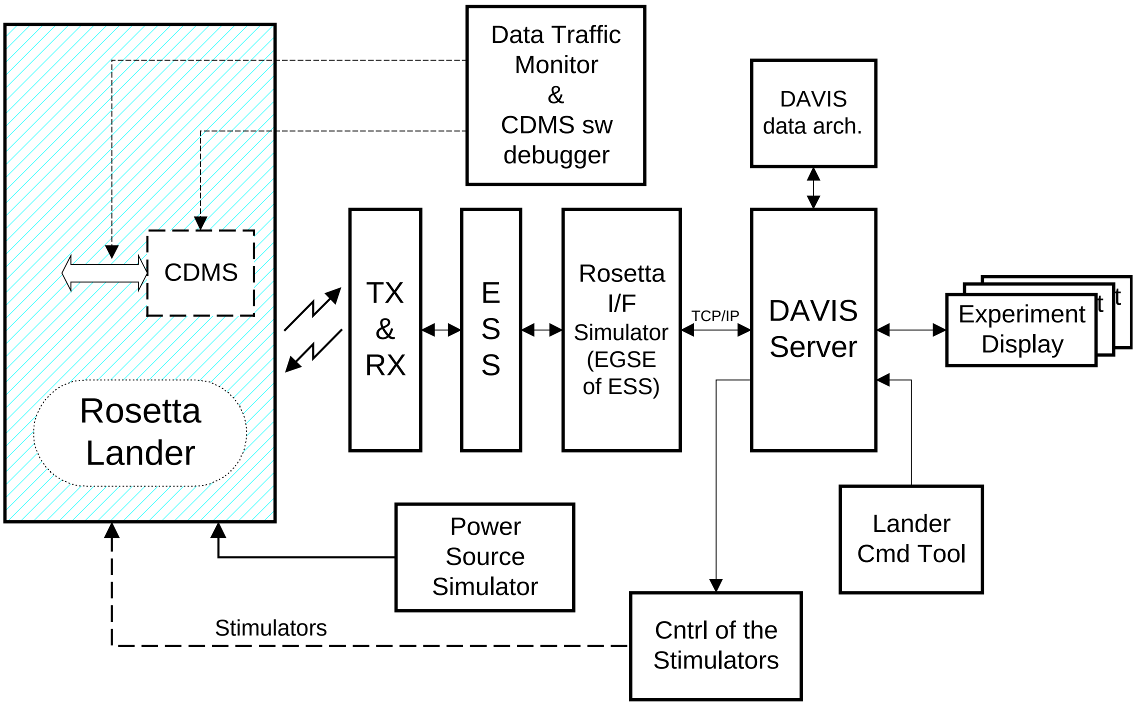


Figure 9-4 Application of Lander EGSE for Rosetta Integration and Verification tests

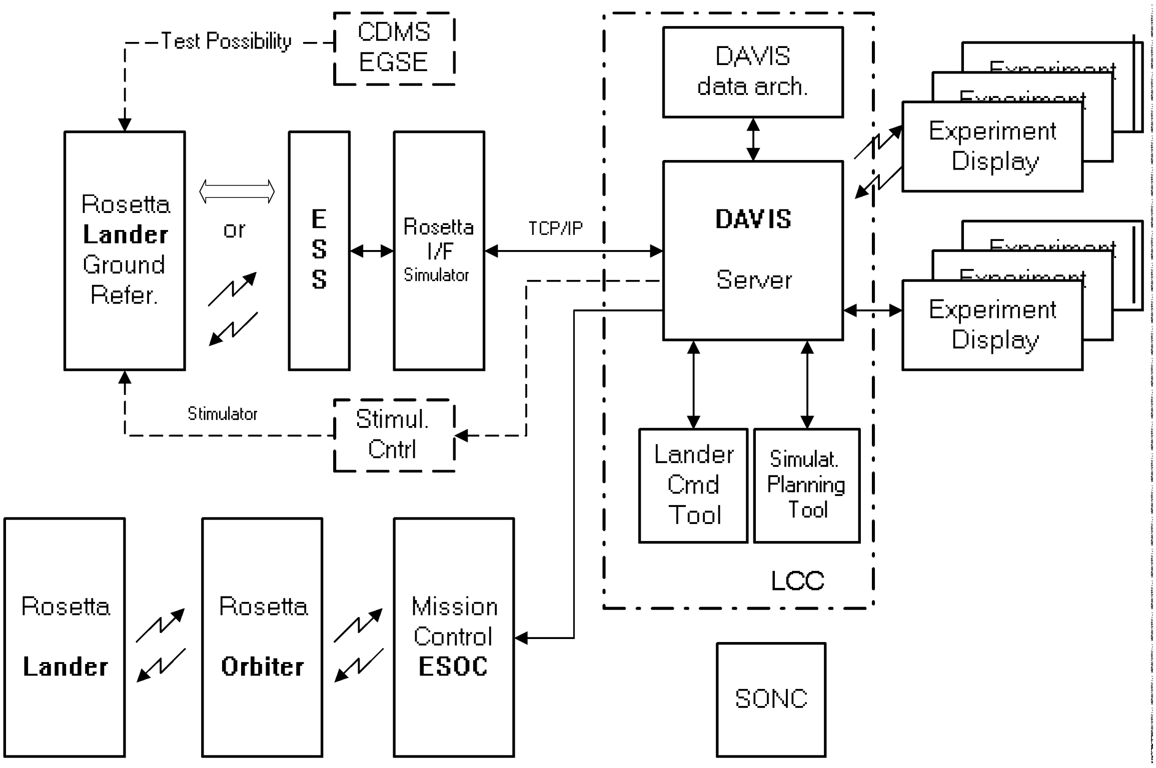


Figure 9-5 The use of the EGSE during mission operation and simulation set-up The detailed characteristics of the hardware set-up are TBD.

9.3.8 EGSE Maintenance

The EGSE will be maintained by the Lander team. All relevant tests on system level will be supported by Lander personnel.

9.4 Mechanical Ground Support Equipment (MGSE)

9.4.1 General

All mechanical ground support equipment needed to support the experiment during system level AIV activities shall be provided by the experiment PI together with written procedures as to its use.

9.4.2 Environmental Cleanliness

Cleanroom class 100,000 (TBD)

9.4.3 Safety Aspects & Load Factors

MGSE Factors of Safety shall be in accordance to LID-A requirements.

10 ROSETTA LANDER GROUND ACTIVITIES

10.1 Model Philosophy

The following model philosophy will apply:

For qualification purposes, two Rosetta Lander models will be built. The Structural/Thermal Model (STM) has been built for development/qualification testing consisting of a flight type basic structure equipped with mechanically and thermally analogues of all experiments and subsystems.

After completion of the tests on Rosetta Lander level, the STM is now available to the Rosetta Project for mechanical and thermal qualification as a part of the Rosetta system.
Test reports are available in the Project Office libray: RO-LAN-RP-[3321, 3320, 3402, 3700, 3325, 3322, 3202-01, 3202-02, 3203], RO-LAN-TN3810, as well as the raw test data.

The Electrical/EMC Model (EQM) will be used for harness and connector layout development, verification of electrical functions, electrical interface testing and EMC tests. The EQM will be integrated from a flight standard basic structure and development models of the subsystems and scientific instruments. For the EMC tests, the subsystems and scientific instruments, power and data harnesses need to be flight identical with respect to their electrical properties. The EQM will be provided to ESA for Rosetta interface/compatibility and overall EMC tests.

For the construction of the Lander as far as feasible, parts and components will be used which are already qualified for their application.

One Flight Model will be manufactured, which undergoes a series of functional, interface and acceptance level environmental tests.
As flight spare the ground reference model (see below) is foreseen. The degree and level of the spare philosophy may vary for the different suppliers but has to be approved by the Lead Scientists and Project Manager. All flight spares will be tested to the same levels as the FM. The FM/spare tests will be performed for single non-integrated instruments or subsystems with test levels which have been derived from the tests of the flight hardware integrated into the Rosetta spacecraft.

The ESA required subsystem spares together with the basic structure from the electrical model and the scientific instrument development models (flight spares) will be integrated into a Ground Reference Model (GRM) immediately after flight model integration.

The GRM is intended for use in case of anomaly investigations during Rosetta integration, pre-launch operations and the mission and as source for unit or even Lander system exchange in case of problems during Rosetta higher integration level activities.

11 FLIGHT OPERATIONS

11.1 General

Mission Operations of the Rosetta Lander are more complex than for a typical instrument, incorporating elements of both an instrument and a spacecraft. For this reason, the Project is planning to perform most operations from a Rosetta Lander Ground Segment (RLGS linked by reliable telecommunications to the RMOC and RSOC in Darmstadt. During all critical operations phases (i.e. 14 days around separation) the Rosetta Lander Project authority will reside at RSOC/RMOC.

The RLGS will conduct all Rosetta Lander operations: post-launch, cruise, near-comet, delivery and on-comet. It will provide PIs with scientific data received from Rosetta Lander.

11.2 Ground Segment And Mission Operations

The CNES/DLR facilities dedicated to the Rosetta Lander mission and data analysis operations called the Rosetta Lander Ground Segment (RLGS), which includes two main centers :

- Lander Control Center located, in Cologne, Germany,
- Scientific Operations and Navigation Center in Toulouse, France.

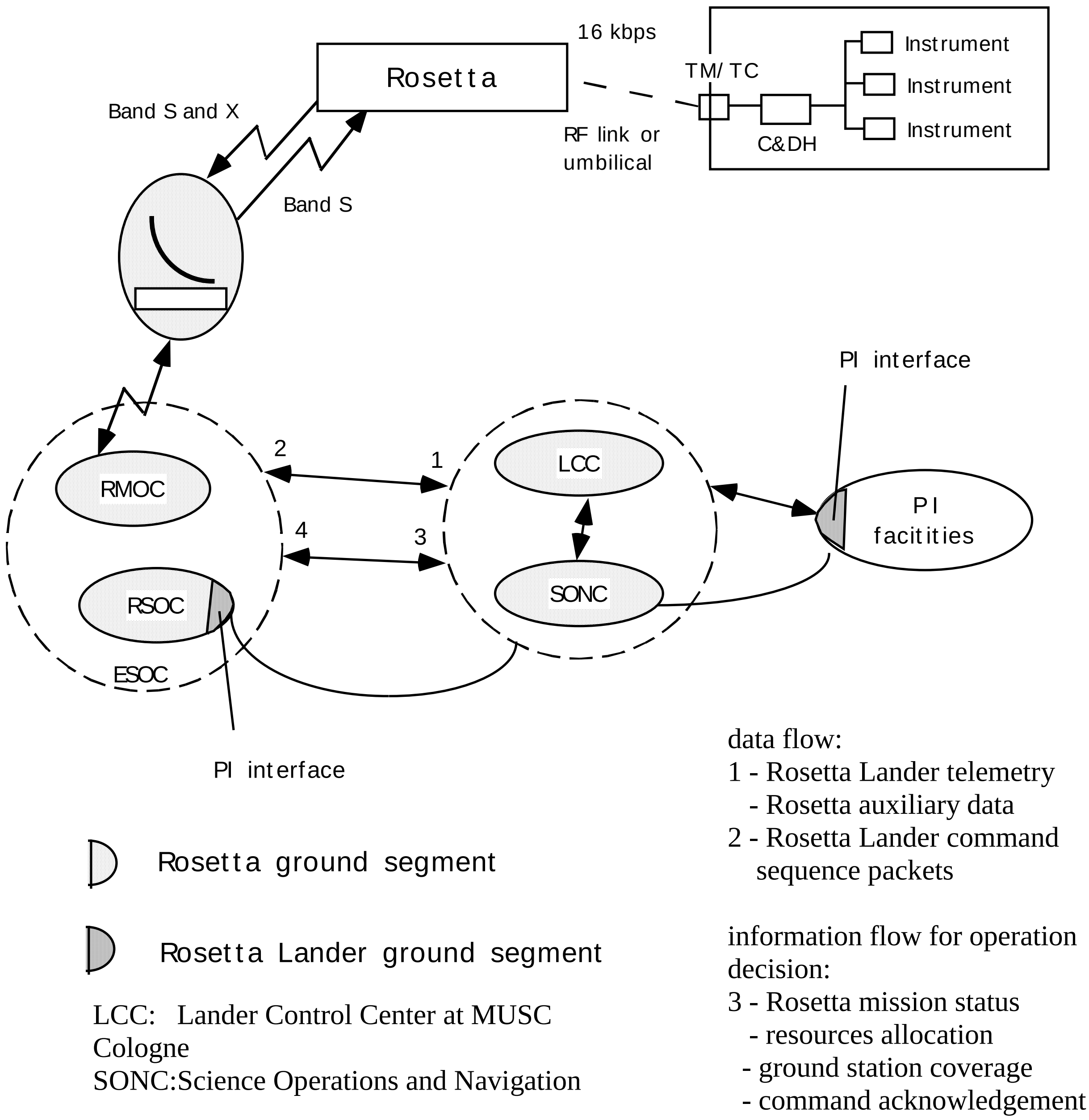


Figure 11-1 General RLGS Architecture

They are operated by the Rosetta Lander Operation Teams, and led by the Ground Segment Manager. All Telecommand and telemetry packets will be routed between the RLGS and the Lander through the RMOC/RSOC and the Rosetta Orbiter.

The scientific requirements on the Rosetta Lander Operation Teams will be issued by Rosetta Lander Lead Scientists, who will co-ordinate all the PI’s requirements and submit an updated science plan. The RLGS will assess it from the operations point of view.

At the RLGS, the operation teams will perform telemetry processing, payload and Lander monitoring, some scientific level 0 processing, quick-look processing, Lander and instrument analysis and prediction, Rosetta Lander operation elaboration, Telecommand processing, and mission analysis.

11.3 Mission Phases

The Lander experimenters have to identify their requirements during the various mission phases:

- Launch phase,
- Commissioning phase,
- Cruise phase (hibernation),
- Mars, Earth gravity assists and asteroid flybys (non-hibernation periods),
- Comet Rendezvous Manoeuvre / Comet Drift Phase / Comet Approach Navigation , and Manoeuvring / Nucleus Mapping and Close Observation,
- Lander pre-delivery, delivery and comet escort to perihelion,
- Lander descent,
- Surface operations - first 5 days,
- Surface operations - long term.

Phase	Phase duration	Lander flight operations control
Commissioning	90 days	- establish baseline performance
Cruise: Hibernation	approximately 8 years	None
Activated		- exercise CDMS system - transmission of housekeeping data - secondary battery treatment - health checkout - calibration - performance tests (some involving synchronisation with Orbiter instruments tests like CONSERT), - mechanical parts exercise (valves, mechanisms)
Comet RDV manoeuvre	113 days	TBD
Comet drift phase	263 days	- exercise CDMS system - transmission of housekeeping data - secondary battery treatment - health checkout - calibration - performance tests (some involving synchronisation with Orbiter instruments tests like CONSERT), - mechanical parts exercise (valves, mechanisms)
Comet approach navigation and manoeuvring	90 days	TBD
Nucleus mapping and close observation	60 days	- evaluation of radiation damage, - complete system and instrument check-out, - modification upload if any, - annealing operations
Delivery preparations	TBD days	- modification upload if any - first sequence programming - calibration measurements - conditioning of Lander and batteries for operational conditions - charging of secondary battery - final delivery parameters upload
Lander separation and descent	<6 hours (TBC)	
Relay-phase operations : first scientific sequence	120 hours	on-comet operations
Long term operations	TBD days	on-comet operations

Table 11-1 Rosetta Lander Flight Operations control for various mission phases

Timeline	TM/TC session	Session duration	Operations	Delay	Data volume
[delivery - x days, delivery - x' days]	TM/TC	few sessions of few hours	- complete checkout, - specific instruments operations,	near real time*	TBD
[delivery - y hours, delivery - y' hours]	TC	few hours	to update tables, software	near real time*	TBD
[landing - 15mn, landing + 15mn]	TM	continuous	to ascertain landing conditions and landing site as soon as possible.	continuous**, or if not possible near real time*	30 Mbit
[landing + 15mn, landing + 24 hours]	TM	a total of 3 hours sharing into a few coms session during the first 24 hours on the comet surface	to acquire the primary science data	continuous**, or if not possible near real time*	173 Mbit
[landing + z hours, landing + 60 hours]	TC	few hours (depending on uploading)	to program the Lander (second scientific sequence)	continuous**, or if not possible near real time*	TBD
[landing +24 hours, landing + 120 hours]	TM	30 min every 16 hours during the last 96 hours (orbit depending - TBC)	to acquire the data of 5 day scientific sequence	continuous for the first 36 hours** (or if not possible near real time), near real time after*	86 Mbit
after 5 day relay phase	TM/TC	15 min every 16 hours (orbit de-pending - TBC)	to program the Lander and acquire the data	as soon as possible***	-14 Mbit per TM session -TBD per TC session

Table 11-2 Communications session between Rosetta Lander and Earth before, during and after delivery (TBC); x, x', y, y', z are TBD.

* means as soon as possible (<TBD hours) for the link Rosetta Lander/Rosetta/Earth
** means that Rosetta Lander is directly accessible from Earth (there are Rosetta Lander/Rosetta and Rosetta /Earth visibility's at the same time)
*** Rosetta Lander has no more the priority regarding the Rosetta Orbiter payload, the delay will be nevertheless less than TBD days.

During these phases, as it is very critical for the Lander, each Rosetta Lander telemetry packets received at RMOC/RSOC shall be immediately forwarded to RLGS.

During the first 5 day relay phase (just after landing), the Lander is the first priority for the Rosetta mission. Telemetry transmission can begin almost immediately after landing, but will include besides science data also housekeeping and engineering data. During the 5 day relay phase operations will be performed on the basis of telemetry data transmitted to Earth. Towards the end of the first 60 hours, new commands (mostly table and parameter updates) will be sent to the Lander via the RMOC and the Orbiter, to program the second 60 hour science sequence. During that sequence, telemetry will again be transmitted to the Orbiter for subsequent down-link to the Earth.

After this 5 day relay phase, the Rosetta Lander will still have communication sessions in order to acquire on ground the telemetry, in order to process it, and send new scientific operations sessions to the Lander. However, the Lander is no more highest priority for the overall Rosetta mission.

12 PRODUCT ASSURANCE

12.1 Introduction

The PA program of the Lander is defined in the Lander PA plan RO-LAN-PL-3201, issue 3, rev.1. In this chapter of the REID-A, special emphasis is on the Lander/instrument interface in the PA context.

12.2 Product Assurance Planning

Each contributor of a Lander subsystem or scientific instrument shall define his product assurance program as part of the REID-B.

The Contributors shall describe the main tasks, the organisation and resources which they assign to their PA program. The person responsible for the fulfilment of the PA program and which is also the interface to the Lander project shall be nominated.

12.3 Quality assurance

Each SI is responsible to verify the performance parameters of his instrument and the requirements imposed on him by the Rosetta/Lander team. He is responsible to conduct tests, inspections and analyses to verify the safe performance of his instrument. The requirements for the documentation of these verifications are defined in the Lander PA plan.

In some cases certain critical functions can only be verified if the instrument is not yet delivered to the Lander, boxes are not closed or relate to safety critical functions. Examples of such functions are:

- Application/verification of safety (pyro!) plugs,
- Tests of safety critical functions,
- Filling of gas tanks,
- Installation of radioactive sources.

These activities require the presence of Lander representatives including PA. The Lander PA will issue a list of the relevant activities (KIP plan = key inspection points). The PI is responsible to inform the Lander team at least one week in advance about the exact date of occurrence.

12.4 Reliability assurance

Reliability assurance shall identify and reduce critical elements in the Lander design. The reliability analysis is performed by the Lander PA team on system and sub-system level, but are also offered to the SI. Nevertheless, inputs are required from the PI's to perform the analyses on system and sub-system level.

It is assumed that it is in the natural interest of each PI to analyse the risk scenario of his interest and to make sure that unacceptable risk conditions for his instrument are avoided and only those risks are accepted which are limited strictly to his instrument. No formal analysis format is required for this assessment, however, the Lander team will provide assistance in this area.

The instrument design shall focus to minimise that risk by application of experience from previous missions and extensive testing for those components for which no reliable data are available.

It is mandatory that the PI demonstrates by analysis and/or testing that no failure condition of his instrument may propagate into the system such that the Lander essential system functions (e.g. CDMS, PWR) are degraded. Especially, the interfacing EEE parts must level Q or equivalent.

12.5 Safety Assurance

Each instrument shall avoid any condition which could result in:

- ground personal injury,
- damage to the Rosetta spacecraft or the Lander,
- damage to ground test equipment.

All operational phases shall be considered.

The following inputs are requested:

- hazard description (what happens...?)
- hazard causes (why, under which conditions...?)

Further data may be necessary on a case-by-case basis. Based on that information, the Lander PA will define appropriate technical countermeasures in conjunction with the PI. Suitable verification methods are defined as well.

The Lander PA includes these data into a formal safety data package to submitted to ESTEC. The PI remains responsible to inform the Lander PA about any safety risk which might be associated to his instrument. Examples for safety relevant components are:

- pressurised systems,
- pyros,
- radioactive sources

12.6 Declared Component List (DCL)

A DCL shall be established listing up all components used in the SI. The Declared Components List (DCL) shall list all electronic, electric and electromechanical components to be used for the instrument. The PI may provide separate lists for the EQM and FM or one consolidated list for both models. In the latter case, those components shall be identified in a dedicated column which are used specifically for the EQM.

The PI shall consider that although the quality standard for the EQM can be less stringent than for the FM, it shall be considered that also the EQM may be subjected to thermal cycling tests and/or vibration tests. In general, commercial/plastic parts are not compliant with that environmental conditions. In those cases, where the EQM is to be refurbished to FS standard, the parts quality needs to be flight standard.

The DCL shall include the following information:

- Identifier,
- Component type,
- Application (location in equipment),
- Applicable procurement specification,
- Actual manufacturer,
- Qualification level (e.g. SCC level B or C),
- radiation tolerance,
- in case, non-qualified parts need to be used, reference to a dedicated qualification program, reference data from comparable previous missions (data to be attached).

Even though the PI is responsible for the selection of the EEE parts of his instrument as far as no interface critical functions are concerned, parts should be selected which are qualified for their task either by their formal qualification status or by proven experience and careful consideration of the PI.

The radiation tolerance of the parts shall exceed 15 krad as a baseline. Deviations shall be discussed on the basis of the location within the Lander (shielding) and the actual parts data.

12.7 Materials and Processes Selection

Each SI shall generate a declared materials list which specifies for all materials used for the construction of the flight model of the Lander:

- unique identifier,
- commercial material identification,
- chemical characterisation,
- procurement information,

- processing information about any processes applied to the material,
- application and environmental conditions within the spacecraft,
- quantity,
- evaluation data; as far as possible, materials which have been qualified for similar applications shall be used.

12.8 Failure/problem reporting

During the manufacturing, assembly and testing of EQM and FM models instrument malfunctions and discrepancies to the expected performance usually occur. Some cases might be of minor nature and are strictly limited to the performance characteristics of the instrument itself (minor non-conformances).

Each PI shall establish a system to eliminate such problems on his own responsibility. Nevertheless, he is required to list these cases and include the list into the acceptance data package to allow the Lander team to assess potential relevance to the system or other instruments.

However, other failures do affect the instrument/lander interface, especially if discrepancies with the REID-B are detected (major non-conformance). These cases require the issue of a formal non-conformance report (NCR). This shall include:

- The affected instrument and equipment item (if possible by reference to a drawing),
- Description of the problem/failure,
- Date of occurrence.

A suitable formsheet is available in electronic format.

The NCR needs to be sent to the Lander team/PA within three working days after occurrence. The Lander PA team subsequently will initiate all following actions which includes as the first action the information of all relevant team members. In general, major non-conformances require the involvement of more than just the instrument PI itself because e.g. other instruments, resources or the overall AIV schedule might be affected.

The convening of the relevant persons (e.g. by phone) is called for historical reasons material review board (MRB). The MRB discusses and decides on the corrective and preventive actions to resolve the problem. The MRB decision is noted in the NCR form such that every affected team member is informed about the course of actions (inc. due dates).

The Lander PA group will monitor the verification of the defined corrective and preventive actions and will close the actions as soon as the required close-out information is available. It has to be noted that the NCR cannot be closed by any other team member than the PA responsible.

In some specific cases, it might be impossible to find a feasible solution such that eventually even a request for a waiver has to be submitted to ESA if a Rosetta requirement cannot be fulfilled. The PI and others then will be requested to provide the Lander team with the rationale supporting information.

12.9 Acceptance data package

Each PI is required to provide an acceptance data package for the STM, EQM and FM. The exact table of contents can be found in RO-LAN-RD-3202, issue 2(EQM (rev.0, dated Sept. 9. 1999).

13 MANAGEMENT

13.1 Organisation and Responsibilities

13.1.1 Institutes Responsibilities

The institutes contributing to the Rosetta Lander project are compiled in Table 13-1 with full institute's name and short name.

Institutes providing Rosetta Lander system contributions	short name in WBS
Deutsches Zentrum für Luft- und Raumfahrt ; Köln, Braunschweig	DLR
Max-Planck-Institute für Aeronomie - Abteilung Rosenbauer , Lindau	MPAe
Max-Planck-Institute für extraterrestrische Physik, Garching	MPE
Centre National d'Etudes Spatiales, Paris,Toulouse	CNES
Agenzia Spatiale Italiana, Roma, Matera	ASI
KFKI Atomic Energy Institute, Budapest	KFKI-A
KFKI Research Institute for Particle and Nuclear Physics, Budapest	KFKI-R
Budapesti Muszaki Egyetem (Technical University Budapest)	BME
Irish Space Technology Institute	STIL
Finnish Metereological Institute, Helsinki	FMI
Rutherford Appleton Laboratory, Chilton	RAL
Institut für Weltraumforschung, Graz	IWF
Institutes providing Rosetta Lander Instruments	**short name in WBS**
Max-Planck-Institute für Chemie, Mainz	MPC
Max-Planck-Institute für Aeronomie, Lindau	MPAe
Institut d'Astrophysique Spatiale, Orsay	IAS
Open University, Milton Keynes	OU
Deutsches Zentrum für Luft- und Raumfahrt; Köln (-KP), Berlin (-BA)	DLR
Universität Münster	Uni. Münster
Max-Planck-Institut für extraterrestrische Physik, Garching* / Technische Universität Braunschschweig	MPE* / TU
Centre d'Etude des Phenomenes, Aleatoires et Geophysiques, St. Martin d'Heres/Service d'Aeronomie du CNES, Verrieres-le-Buisson	CEPHAG/SA
Politechnico Milano	PMi

Table 13-1 Institutions cooperating in the Rosetta Lander Project

*** responsibility for the joint project ROMAP.**

Lead Scientists :

Dr. Helmut Rosenbauer - MPAe
Dr. J.P Bibring - IAS

Principal Investigators (PIs) of Rosetta Lander instruments:

Dr. Hans-Ulrich Auster, Dr. Jean Pierre Bibring, Dr. Wlodek Kofman,
Prof. Dr. Diedrich Möhlmann, Dr. S. Mottola, Prof. Dr. C. T. Pillinger,
Dr. Rudolf Rieder, Dr. Helmut Rosenbauer, Prof. Dr. Tilman Spohn, Prof.a A. Ercoli-Finzi.

13.1.2 Functional Organigramme

The functional organigramme of the Rosetta Lander Project is shown in Fig. 13-2.
The Rosetta Lander project is a co-operative effort of research institutes and space agencies (listed in Table 13-1) with the goal to design, manufacture, test, validate, and operate the Rosetta Lander in order to provide the opportunity for scientific investigations on a cometary nucleus.
The institutes providing contributions to the Rosetta Lander system and space agencies providing financial support are represented in the Steering committee. Day-to-day project management is performed by the Rosetta Lander Project Office under the responsibility of the Project Manager. The Project Manager is supported by two Co-Project Managers. The Project Manager and the Co-Project Managers are responsible for co-ordination of the complete Project. Each Co-Project Manager is responsible for the contribution of the Work Packages of his respective country.
The scientific co-ordination of the Rosetta Lander is performed by two Lead Scientists acting sequentially as spokesperson.
The Lander platform engineering, the Lander AIV, the payload engineering, the mission analysis/navigation and the operations and ground segment management are performed by the System Team, under the responsibility of the System Engineer.
The Product Assurance Engineer reports directly to the Project Manager.

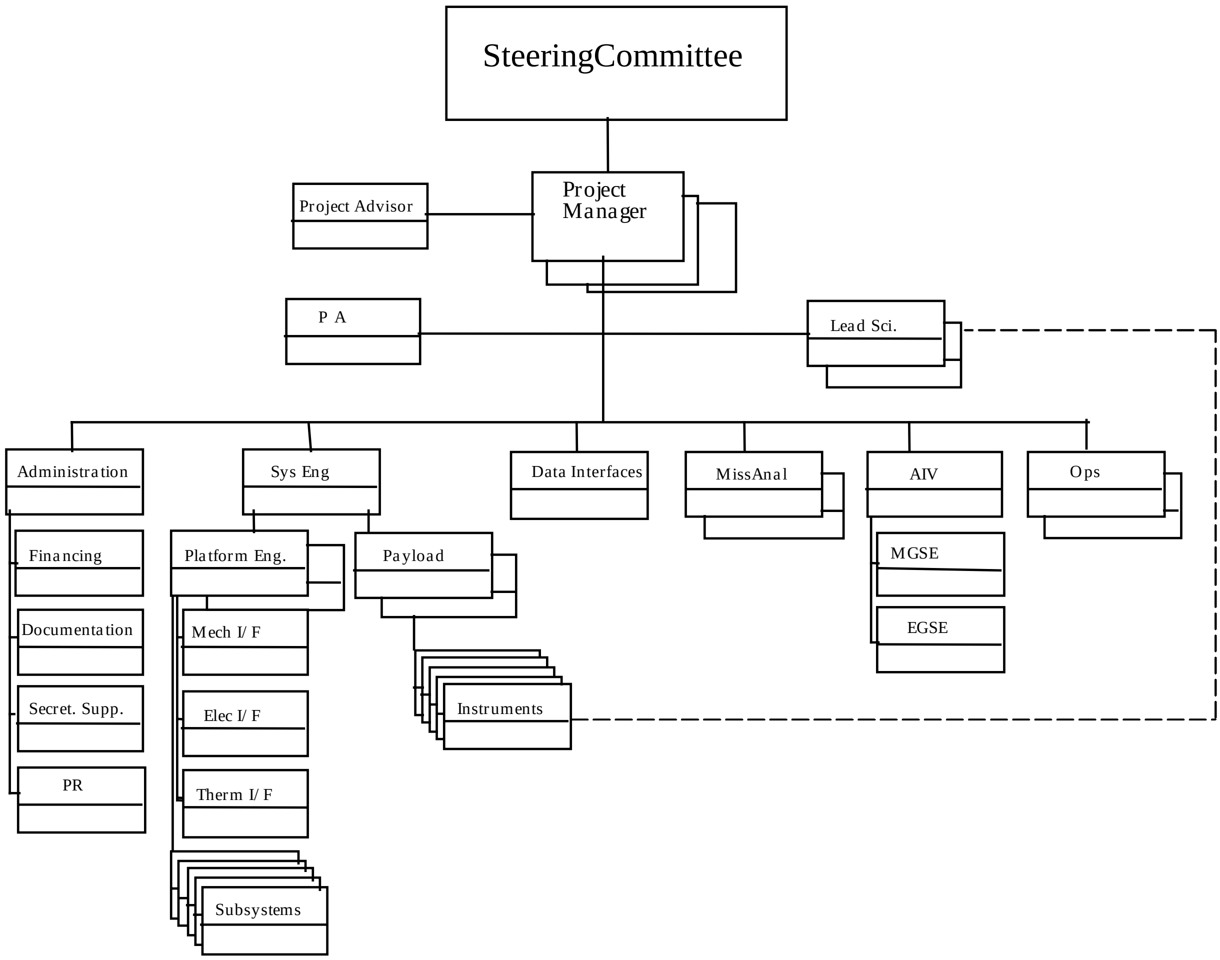


Figure 13-1 Rosetta Lander Project Organisation

It is important to note that the Co-operation of the institutes of the Rosetta Lander consortium is based on a best effort agreement with no exchange of funds between the partner institutions.

The Rosetta Lander instruments will be provided by Instrument Teams, headed by PIs. The PIs will be responsible for technical realisation of their instruments interfacing to the Rosetta Lander as defined in the respective REID-A and REID-B documents within the schedule given in section 4. The PIs will be responsible for the funding of their contributions. They will form the Science Team, which is chaired by the Lead Scientists.

13.2 Key Personnel

The following key personnel has been identified:

Chairperson of the Rosetta Lander Steering Committee: Dr. K. Szegö

Project Manager:	Dr. S. Ulamec
Deputy Project Manager:	Prof. D. Moura
Deputy Project Manager:	Dr. R. Mugnuolo
Lead Scientist:	Dr. H. Rosenbauer
Lead Scientist:	Prof. Dr. J. P. Bibring
System Engineer:	H.-J. Schuran
Project Advisor:	H.-J. Schuran
Product Assurance Engineer:	Dr. Johannes Boßler
Platform Engineer	H-P. Schmidt
AIV - Engineer	Dr. G. Gritner
Data I/F manager	T. Trautmann
Project Office Administration, Financing	U. Jacobs
Operations and Segment Operations Engineer	P. Rangeard
Mission Analysis - Navigation Engineer	F. X. Chaffaut
Payload Manager*	Dr. J. Biele
Payload Engineer**	P. Hemmerich
Mech. I/F	U. Ragnit
Electrical I/F	G. Warmbold
Thermal I/F	H.-P. Schmidt
MGSE	T. Neuhausen
EGSE	R. Schmidt, T. Trautmann
PR	U. Ragnit

* supported by P. Rangeard for French Payload Instruments
** supported by M. Cau for French Payload Instruments

It is important to note that the co-operation of the institutes of the Rosetta Lander consortium is based on a best effort agreement with no exchange of funds between the partner institutions.

13.3 Experiment Team Organisation

The interface for the experimenters on Lander side are the Rosetta Lander Lead Scientists. They represents the responsible proposers in the Rosetta Science Working Group (or Rosetta Experimenter Meetings, respectively).

Technical questions can also be addressed to the Rosetta Lander System Engineer, who acts as an interface to the Lander sub-system teams.

In the REID, part B, the team structure for the experiments shall be described. Steering mechanisms, co-ordination, involved agencies (on both, programmatic and implementation level) shall be identified. Key personnel shall be named.

14 PROGRAMME AND SCHEDULE

14.1 Overall Programme

The Rosetta Lander Overall Programme is defined within the Rosetta Lander Project Plan.

Beside the technical challenge of the Rosetta mission itself and the Lander especially, the main objective of the Lander mission is to secure the scientific performance of the Lander Payload according the scientific requirements and the data transfer to the PIs on ground.

The direct I/F to the Rosetta Orbiter (Mounting, Integration, Test, CDMS, Power, Thermal), especially the boundary conditions of the fixed launch date, makes a co-ordinated strategy for the entire Lander system, including Payload absolutely necessary, respecting the Rosetta Master Schedule. As Payload might become a driver for the Lander development itself, a tool to co-ordinate and follow the ongoing activities on Payload side has been established (see 14.2 Rosetta Lander Payload Review Cycle).

14.2 Rosetta Lander Payload Review Cycle

14.2.1 General Review Organisation and Parallel Activities

A Review cycle for the Lander payload instruments has been established, adopted to ESA rules for the Rosetta Orbiter payload as specified in the EID-A issue 2, Rev. 0, (Ref.: RO-EST-RS-3001/EID A).

The Rosetta Lander Payload Review Cycle consists of

- Payload Preliminary Design Review - PPDR (done, January 19 – 22, 1998),
- Payload Final Design Review - PFDR,
- Payload Flight Operations Review - PFOR.

To enhance the development of the follow the Payload instrument and to follow the evolution within the Rosetta Lander Master Schedule the following activities on Lander on Lander Payload instrument side are requested and will be supported by the Lander Project :

- Payload Instrument Progress Meetings, under PI responsibility,

- Rosetta Lander Experimenter Working Group Meetings under Lead Scientists responsibility.

14.2.2 Review Cycle – Definition

14.2.2.1 Payload Preliminary Design Review - PPDR (included for historical reasons)

The PPDR was intended to assess the maturity of the Payload Instrument conceptual Design and ensure that the requirements are compatible with the Rosetta Lander System Baseline.

A satisfactory completion of the PPDR is to be seen in an updated REID-B, which from now on is under configuration control. The improved design, established in the REID-B is intended to be the technical baseline to be used for manufacturing and production of the Payload Instrument models STM and EQM.

The PPDR has been performed (January 19 – 22, 1998) at DLR Cologne. The results have been reported to the Rosetta Lander Steering Committee, the REID-B updates were completed mostly by mid-1998.

14.2.2.2 Payload Final Design Review – PFDR

The PFDR will assess the Payload Instrument Design and its interface requirements and confirm their compliance with the Rosetta Lander system.

The PFDR will take place in early 2000 (TBC).

14.2.2.3 Payload Flight Operations Review - PFOR.

The PFOR will assess the flight readiness of the Payload Instrument and confirm its compliance with all elements of the mission.

As a result of this review all related flight operations documents (REID-B, User Manuals, Flight Operations Plan) will be updated in order to contain the latest agreed requirements.

The PFOR will take place in early 2002 (date TBD).

14.2.3 Parallel Payload Activities

14.2.3.1 Payload Instrument Progress Meetings

Rosetta Lander Payload Progress Meetings shall take place at regular time intervals (one meeting per year at least – under PI responsibility) and in principle at the premises of the Principal Investigators and the Payload Manager / Engineer.

These meetings shall be held during the experiment design, development and verification phases or at any time felt necessary by the Payload Manager / Engineer.

The meeting´s objective will be to review in principle the experiment status, ensure its compatibility and make sure that progress and / or related problems are dealt with in a controlled and prompt manner.

Beside the Payload Manager / Engineer involvement, the Progress Meetings are supported by representatives of the Rosetta Lander Project office on request.

14.2.3.2 Rosetta Lander Experimenter Working Group EWG

The EWG is chaired by the Rosetta Lander Lead Scientists.

The EWG represents the general assembly of all Rosetta Lander Principal Investigators and acts as a forum for information and interaction of general science and project related matters. The EWG is also the forum to address detailed and specific scientific matters and requirements, which are to be discussed and co-ordinated by the Scientists involved.

The ROSETTA Project Scientist will be invited as a member of the Lander EWG and adviser for all Mission Science related matters.

The EWG advises via the Lead Scientists the Rosetta Lander Project Manager on all scientific matters related to the mission.

The responsibility to decide on conflicts, which are related to instrument preparation, implementation and performance and cannot be settled conjointly between the Scientists is on Lead Scientists. As far as the Lander project is concerned, the Project Manager takes responsibility.

As fare as no common understanding can be reached between the Lead Scientists and the Project Manager the conflict will be addressed to the Rosetta Lander Steering Committee for recommendation. Final responsibility stays with the Project Manager.

A EWG is foreseen to take place once a year.

14.2.3.3 Science Working Group (SWG)

The SWG is operationg on Rosetta level; all Rosetta PIs are invited to semiannual SWG meetings by ESA, where the Lander PIs have two votes.

14.3 Reporting and Monitoring

A bi-monthly Payload Instrument Progress Report under PI responsibility is requested by the Payload Manager / Engineer to establish the necessary information exchange between Payload and System. A formalised template, intended to minimise the effort to be taken, will be distributed to the PIs.

14.4 Schedule

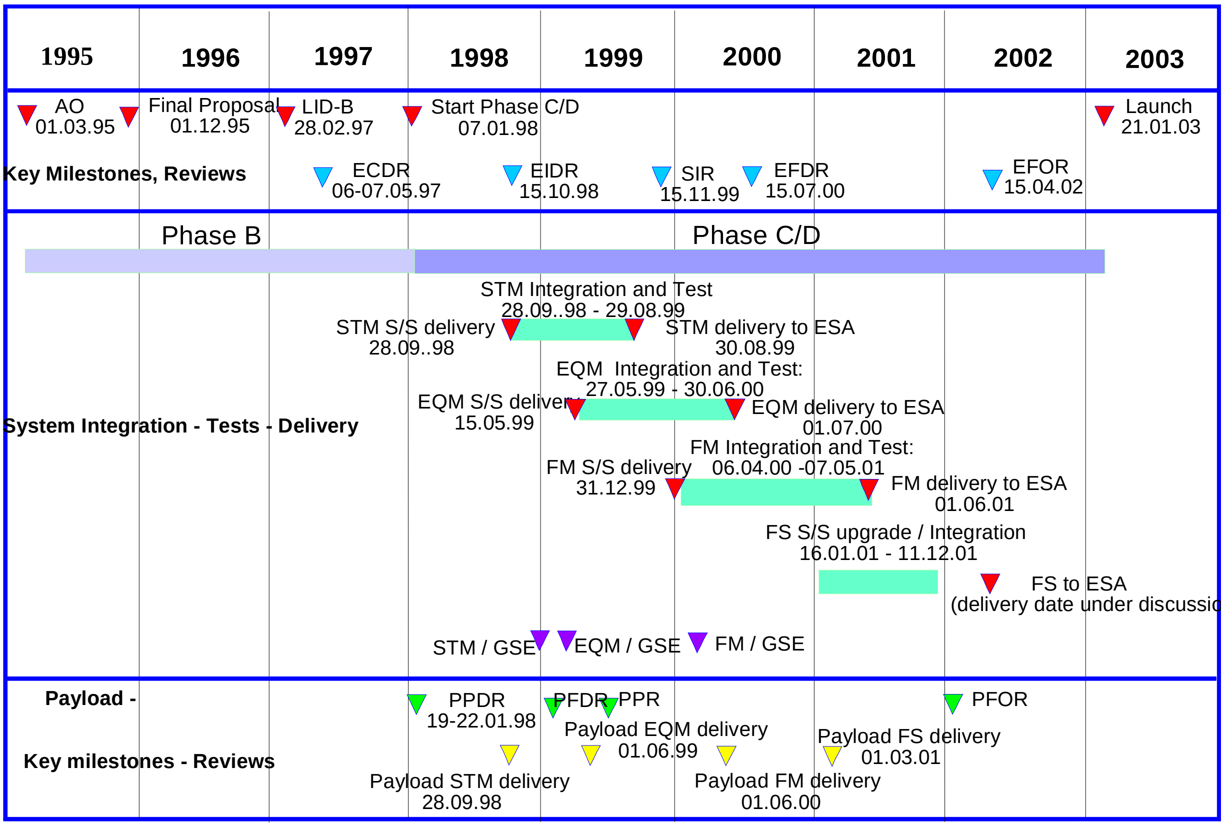


Figure 14-1 ROSETTA Lander Schedule of major milestones and activities.

PPR: Preliminary Payload Review

14.5 Deliverable items

14.5.1 Hardware and Software

It is planned to deliver (after the Structure/Thermal Qualification Model (STM)), an Electrical/EMC Qualification Model (EQM) and a Flight Model (FM) to ESA. The delivery dates are given in Figure 14-1. The flight spare and ground reference model (GRM) is foreseen as a preferably complete redundant system .

14.6 List of Acronyms

ADS	Active Descent System
AIT	Assembly, Integration and Test
APX(S)	Alpha Proton X-ray Spectrometer
ASI	Agenzia Spaziale Italiana
AU	Astronomical Unit
CASSE	Comet Acoustic and Seismic Sounding Experiment
CCB	Configuration control board
CDMS	Rosetta Lander Command and Data Management System
CDR	Critical design review
CFC	Carbon Fibre Composite
CI	Configuration item (e.g.structure, landing legs)
CIDL	Configuration items data list
CIU	Centra lInterface Unit insideCDMS
ÇIVA	Comet Nucleus Infrared and Visible Analyzer
CNES	Centre Nationale d'Etudes Spatiales (French Space Agency)
CoM	Center of Mass
CONSERT	Comet Nucleus Sounding Experiment by Radiowave Transmission
COSAC	Cometary Sampling and Composition Experiment
CWC	Common Working Circle
DCL	Declared Components list
DIM	Dust Impact Monitor
DLR	Deutsches Zentrum für Luft- und Raumfahrt e.V.
E-Box	Common Electronic Box
ECDR	Experiment Conceptional Design Review
ECP	Engineering change proposal
EEE(part)	Electrical, electronic, electromechanical part
EGA	Evolved Gas Analyser
EGSE	Electrical Ground Support Equipment
EID	Experiment Interface Document
EID A	Experiment Interface Document , Part A
EIRD	Experiment interface requirements document
EMC	ElectroMagnetic Compatibility
EPROM	Erasable Programmable ROM
ESA	European Space Agency
ESO	European Southern Observatory
ESS	Electrical Support System
ESTEC	European Space Research and Technology Centre
FMECA	Failure Modes Effects and Criticality Analysis
FMI	Finnish Meteorological Institute
FoV	Field ofView
FPGA	Field Programmable Gate Array
FTA	Faulttreeanalysis
GaAs	Gallium Arsenide
GCMS	Gas Chromatograph Mass Spectrometer

GN2	Gaseous Nitrogen
GRS	Gamma-Ray Spectrometer
GSE	Ground Support Equipment
H/K	Housekeeping
HGA	High-Gain Antenna
I/F	Interface
IWF	Institut für Weltraumforschung, Graz
JPL	Jet Propulsion Laboratory
KFKI	Hungarian Institutes: Research Institute for Atomic Energy
KIP	Key inspection point
LG	Landing Gear
LGA	Low Gain Antenna
LID-B	Lander Interface Document, Part B
MGA	Medium-Gain Antenna
MGSE	Mechanical Ground Support Equipment
MIP	Mandatory inspection point
MLI	Multi-Layer Insulation
MoI	Moment of Inertia
MoM	Minutes of Meeting
MPAe	Max Planck Institute for Aeronomy
MPG	Max Planck Gesellschaft
MSB	Most SignificantBit
MSS	Mechanical Support System
MUPUS	Multi-Purpose Sensor for Surface and Subsurface Science
MUSC	Microgravity User Support Center
NASA	National Aeronautics and Space Administration
NCR	Non-conformance report
OBDH	On board data handling
PCU	Power Control Unit
PDR	Preliminary design review
PEN	Penetrator
PI	Principal Investigator
PPS	Productions Planning and Control System
Pro/E	Pro/Engineer
RAL	Rutherford Appleton Laboratory
REID	RosettaLander Experiment Interface Document
REID-A	Rosetta Lander Experiment Interface Document, Part A
REID-B	Rosetta Lander Experiment Interface Document, Part B
RF	Radio Frequency
RHU	Radioisotope Heater Unit
RIU	Remote Interface Unit inside SS
RoLand	Rosetta Lander (= SSP)
ROLIS	Rosetta Lander Imaging System
ROM	ReadOnly Memory
ROMAP	Rosetta Magnetometer and Simple Plasma Monitor
RP	Reference Point
S/S	Sub-System
SD2	Sample and Drilling Device

SESAME	Surface Electrical Seismic and Acoustic Monitoring Experiment
SI	Scientific instrument
SPC	Science Program Committee
SS	Subsystem/Experiment
SSADR	Subsystem address word
SSCMD	Subsystem command word
SSDATA	Subsystem data word
SSP	Surface Science Package
SSREQ	Subsystem request word
TBC	To Be Confirmed
TBD	To Be Defined
TCS	Thermal Control System
TM	Thermal Mapper
TxRx	Telecommunications System
URF	Unit Reference Frame
VCD	Verification control document
VCP	Verification control plan

15 ROSETTA LANDER INFORMATION WEB-SERVER

15.1 The idea behind the machine

The Rosetta Lander Web-Server was installed to improve the information interchange between the numerous project members. Documents, drawings and pictures are accessible from all around the world by using today's standard web-browsing utilities, like Netscape Navigator 4+ or Microsoft Internet Explorer 4+.
The server hosts several mailing lists used to announce new entries to subscribed users and provides additional services like a list of upcoming events, a searchable address book and several FTP directories which can be used to transfer files between project members.

15.2 How to contact the server

The server is located at the Max-Planck-Institute für Aeronomie (**MPAe**) in Lindau. Simply direct your favourite browser to the following URL:

http://roland.mpae.gwdg.de

and the index page will be displayed.

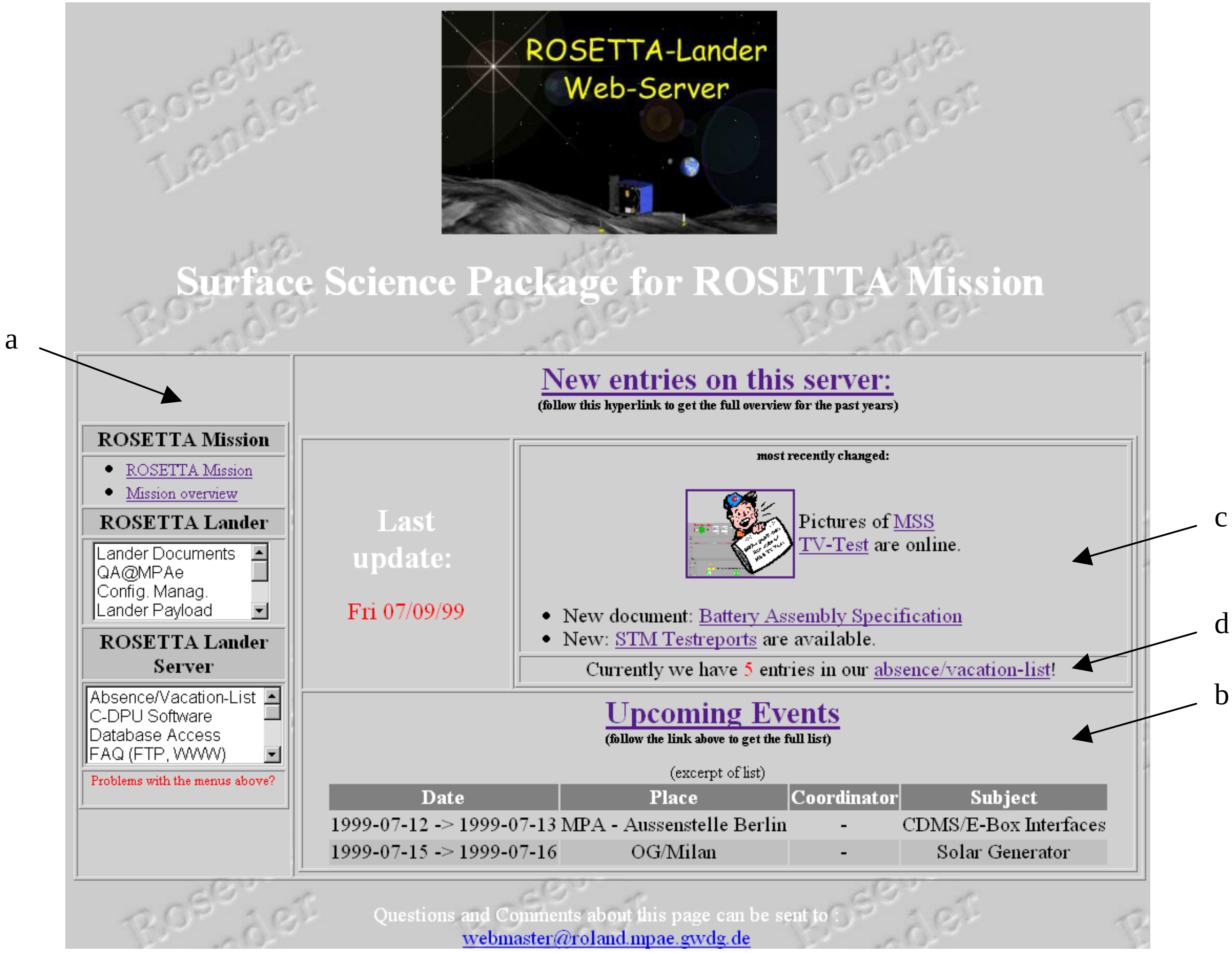


Figure 15-1: Homepage of the RoLand WebServer http://roland.mpae.gwdg.de

The index page is divided into several sections:

a) Links to documents & sections
Here you can find several links to sections and documents that are store on our server. Scroll through the lists and simply click on the entry you would like to read1.

b) List of upcoming events
In here you will find an automatically generated list of forthcoming events that are currently stored in our database. To see the full list or add a new event, click on 'Upcoming Events'.

c) List of new entries
To keep track of all the changes taking place on this server, we have installed a history list. All entries in that list are sorted by date. The most recent changes are displayed in section c), click on the hyperlink 'New entries on this server' to access the full history list.

d) Absence/vacation list
Follow this hyperlink to get a list of project members who are currently 'out-of-office'. To add yourself to the list, simply fill out the predefined form.

15.3 How to access documents/data and other stuff located on the server

15.3.1 Data formats

Before we talk about how to fetch documents from our site, let us discuss an important topic first: **data formats**.
With every new program designed to deliver the best performance in processing your data, enhancing your diagrams and managing your appointments comes a new format to store all that information in. We can not and will not store documents in several different versions, just because there is an Office software that is incompatible to itself with every new version published. Because of this, we decided to use a platform independent file format to store most of the files on this server in. We've chosen the Portable Document Format (**PDF**) created by Adobe®, because you can download a reader for nearly every operating system, the format is extremely compact, supports built-in compression, but the best part is still to come: it's free of charge!
So, if you haven't already installed it, go to http://www.adobe.com and download the Adobe Reader for your operating system.
While we're at it, make sure that an archive utility like **WinZip** is installed on your computer. Several files are stored in ZIP archives, simply to speed up the download on remote clients. Go to http://www.winzip.com to download an evaluation copy of this great program.

1 If you run into problems selecting the entries inside the scrollboxes, your browser apparently does not support JavaScript. Use the hyperlink right at the bottom of section a) instead! It's linked to an extra page where the old-style list of links is still available.

Here's a list of additional file formats you will find an our server:

File suffix	Description	Viewer
ps	Postscript file	Ghostview
doc	Microsoft Word document file	Microsoft Word or compatible
xls	Microsoft Excel file	Microsoft Excel or compatible
gif	CompuServe Graphics Interchange	Netscape Navigator, Internet Explorer, ACDSee, Paint Shop Pro, every std. image-editing software
jpg	JPEG format	same as above
avi	Microsoft Audio/Video interchange format	Windows Media Player
mov	Quicktime movie file	Quicktime Movie Player
mpg	Moving Picture Experts Group video format	Windows Media Player
ram	RealVideo format	RealPlayer G2

Table 15-1 File formats on our server

When a new file format is published on our server, you will usually find a hyperlink to a site where the appropriate player/viewer is available for download.

15.3.2 Downloading files

Have a look at Fig. 15-2. It is an example for the user interface we have created to make the download of files located on our server as simple as possible. The table in Fig. 15-2 is divided into 4 columns:

- **file description**
  This is the place to display the name of the file and additional data (doc.-ids, ...)

- **updated**
  This entry shows the date the file was added/updated on our server.

- **access status**
  Part of the data stored on this server is password protected. Two icons are used to display the accessibility status:

	File is accessible to **registered** users only.
	File is accessible to everyone on the net.

- **download**
  To download a file, simply click on the 'x' in one of the sub-columns.
  If you are trying to download a password-protected file, your browser will pop up a window, asking you to enter your username and password.

file description	updated (mm/dd/yy)	access status	download	
			pdf.zip	hpgl
REID-B New!	(10/09/98)		x	
add. technical drawings	(10/08/98)			x

Figure 15-2 downloadning files

15.3.3 Uploading files

If you have any files you want us to publish on the server we can offer you the following possibilities for sending them to us:

a) **Email**
Of course, if your files do not exceed a limit of, let's say, 2 Mbytes in total, you can always send them to us by email (Don not forget to compress them first!). Your focal point of contact on the server as always is

webmaster@roland.mpae.gwdg.de.

Please tell him what you want him to do with your files.

b) **File upload via WWW-Interface**
By far the most comfortable way for uploading data to our server is via the WWW-Interface, shown in Figure 15-3.
In order to upload data, you have to enter your name, your email address and an addressee (simple by picking one from the predefined list). Leave us some information on what you like to do us with your data in the textbox and click on the 'Browse' buttons at the bottom of the page to select the files on your local drive. If these buttons are not shown in your browser, you have to upgrade to a newer version! A patch for Internet Explorer 3.02 is available for download at the top of the page.
The limit for uploading data through the WWW-Interface is currently set to 5 files totalling in 10 Mbytes.

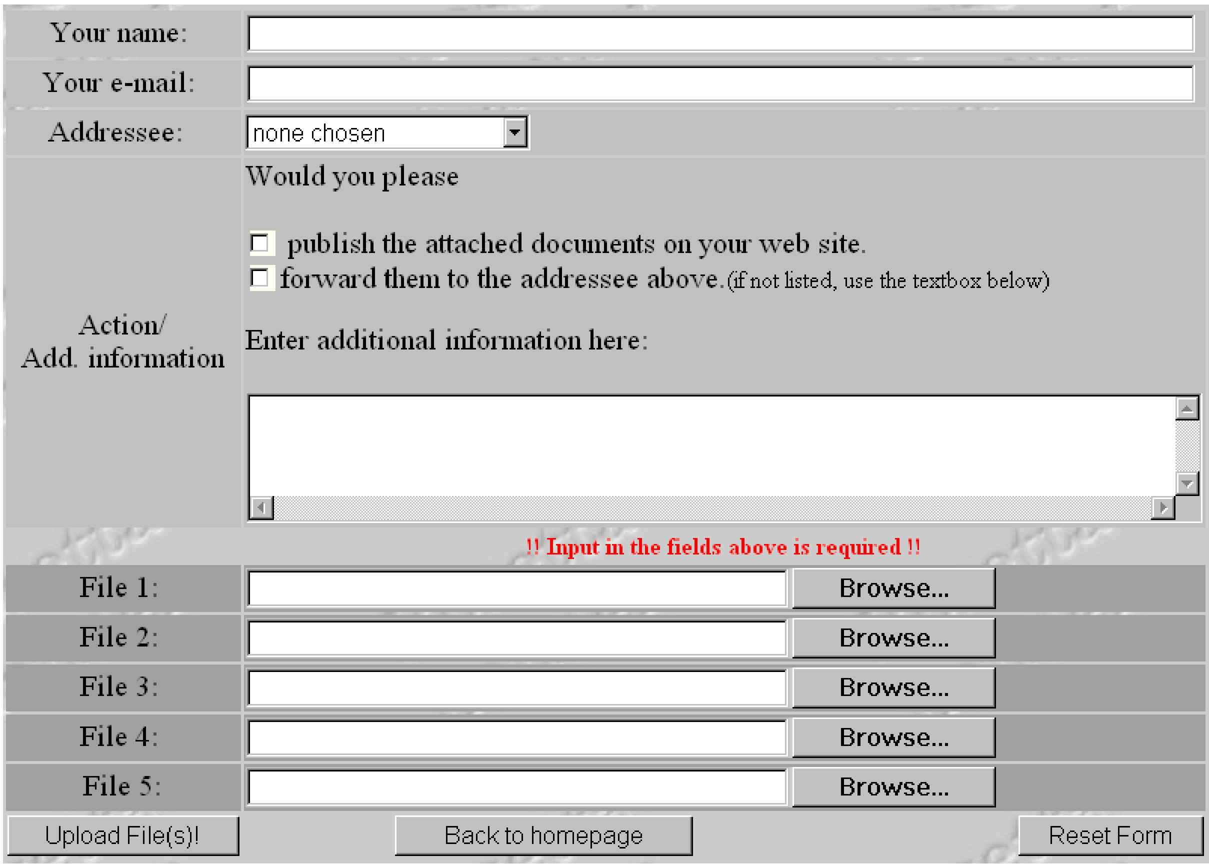


Figure 15-3: Uploading files http://roland.mpae.gwdg.de/upload/upload.html

c) **File Transfer Protocol** (FTP)

If your data exceeds both limits set by possibility a) and b), don't worry, using FTP gives you unlimited data transfer access! Well, almost ...
To transfer data using the File Transfer Protocol, you need a special program, called an FTP-Client. Most of todays operating systems are shipped with a copy of such a program (at least with a command line version of it).
During this introduction I will use WS_FTP2 on Win9x/NT, an FTP-Client with a graphical user-interface. (It's free for academic and non-commercial home use!)

First let's talk about the directory structure on the remote host that you have to keep in mind while working with FTP:

```
dr-xr-xr-x  25 root   other     1024 Jul 15 14:36 .
drwxrwxr-x   6 root   other      512 Jul 15 14:28 ..
drwxrwx---   3 root   ftpasi     512 May 15  1998 asi_documents
drwxrwx---   3 root   ftpct      512 May 15  1998 cnes_toulouse
drwxrwx---   9 root   ftpdlr     512 Jul  5 09:53 dlr_documents
drwxrwx---   3 root   ftpestec   512 May 15  1998 estec_documents
drwxrwx---   2 root   ftpfmi     512 May 15  1998 fmi_documents
drwx-wx-wx   2 root   ftp        512 Jul 15 15:54 incoming
drwxrwx---   5 root   ftpkfki    512 Jul 15 12:12 kfki_documents
drwxrwx---   3 root   ftpmpae    512 Jul 15 12:03 mpae_documents
```

2 WS_FTP is available at http://www.csra.net/junodj/

```
drwxrwx---   2 root     ftpmpe      512 Dec  1  1998 mpe_documents
drwxrwx---   3 root     ftpou       512 May 15  1998 ou_documents
drwxrwxr-x   2 root     ftp         512 Jul 18 15:50 transfer
drwxrwx---   3 root     ftposaka    512 Jan  5  1999 uni_osaka
```

You may have already noticed that we have several directories dedicated to institutes participating in the Rosetta Lander project. The correct assignment is done by our server based on the accessing clients domain name. Read and write access to the corresponding directory is granted to the client once its domain name was successfully recognised.
What's that all about, you may ask yourself?
Well, it's a way to exchange data between project members without using email.
You can store files in your directory and ask us to copy them into another one. Of course, it works the other way around, too!

For those of you currently not having a dedicated directory, we have created **incoming** and **transfer**. These directories have directly reverse access permissions for everybody.
While incoming is writeable, transfer is readable only.
Files copied to incoming will be automatically transported to transfer and removed within 3 days!

Let's start with a brief FTP introduction here:
Have a look at Figure 15-4. WS_FTP lets you manage different FTP-Sessions, each of them uniquely identified by a profile name.
I called this session **roland-anonymous** and already entered the **Host Name** 'roland.mpae.gwdg.de', **User ID** 'ftp' and my full email address as the **Password**.
Additionally, I have set the initial directory on the remote host to be **/pub/incoming**, which is where you have to upload your data files if you don't have a dedicated directory!
Once you have opened the connection (by clicking on 'Ok') WS_FTP will let you store data on the remote system via simple drag-and-drop. Yes, it's that easy!

Please keep in mind: **You can not read the /pub/incoming directory!**

For a detailed description on how to use the ftp command line tool and a complete Server-FAQ direct your browser to: http://roland.mpae.gwdg.de/FAQ/faq.html

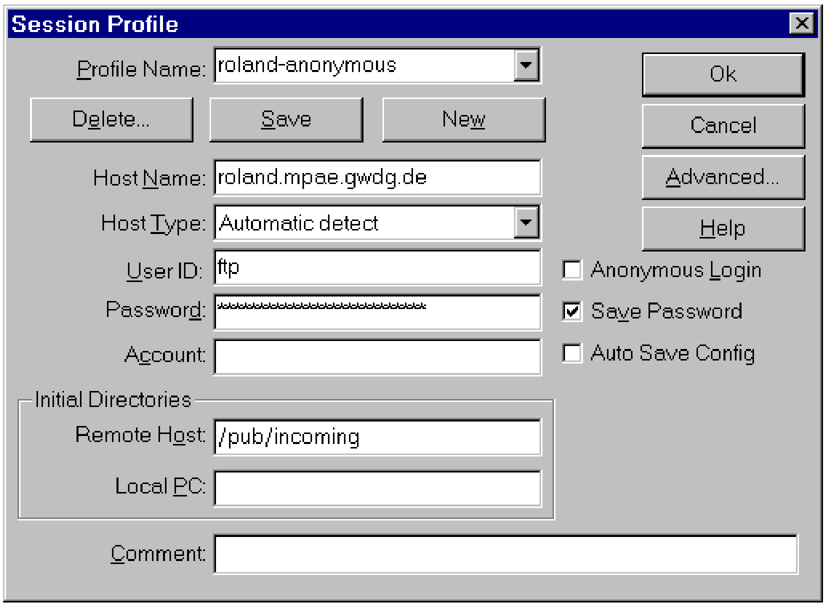


Figure 15-4 a ftp session

15.4 How to become a registered member

15.4.1 Registration process

As it was already mentioned above, part of the data stored on our server is accessible to registered users only:

- most of the project documents
- project address book
- FAX repository
- automatically generated document identifiers

Figure 15-5 shows the requester that is displayed by a users browser right after the download of a 'members-only' item was initiated: Username and Password required!

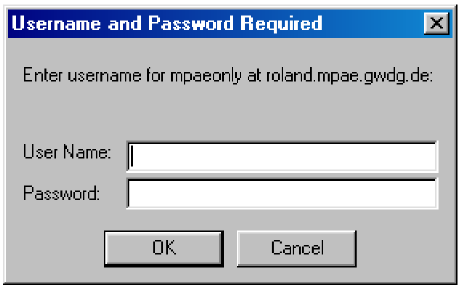


Figure 15-5 registration requester

Direct your browser to the URL below and gain access to the private areas on our server by subscribing yourself to it.

http://roland.mpae.gwdg.de/cgi-bin/register.pl

All you have to do is fill out the form, shown in Figure 15-6**.**
Enter your full name, your email address, pick your organisation from the drop-down list and choose your own Username/Password[3] combination!

3 Username and Password are case sensitive! Your browser will remember them during the current session, so you don't have to enter them over and over again.

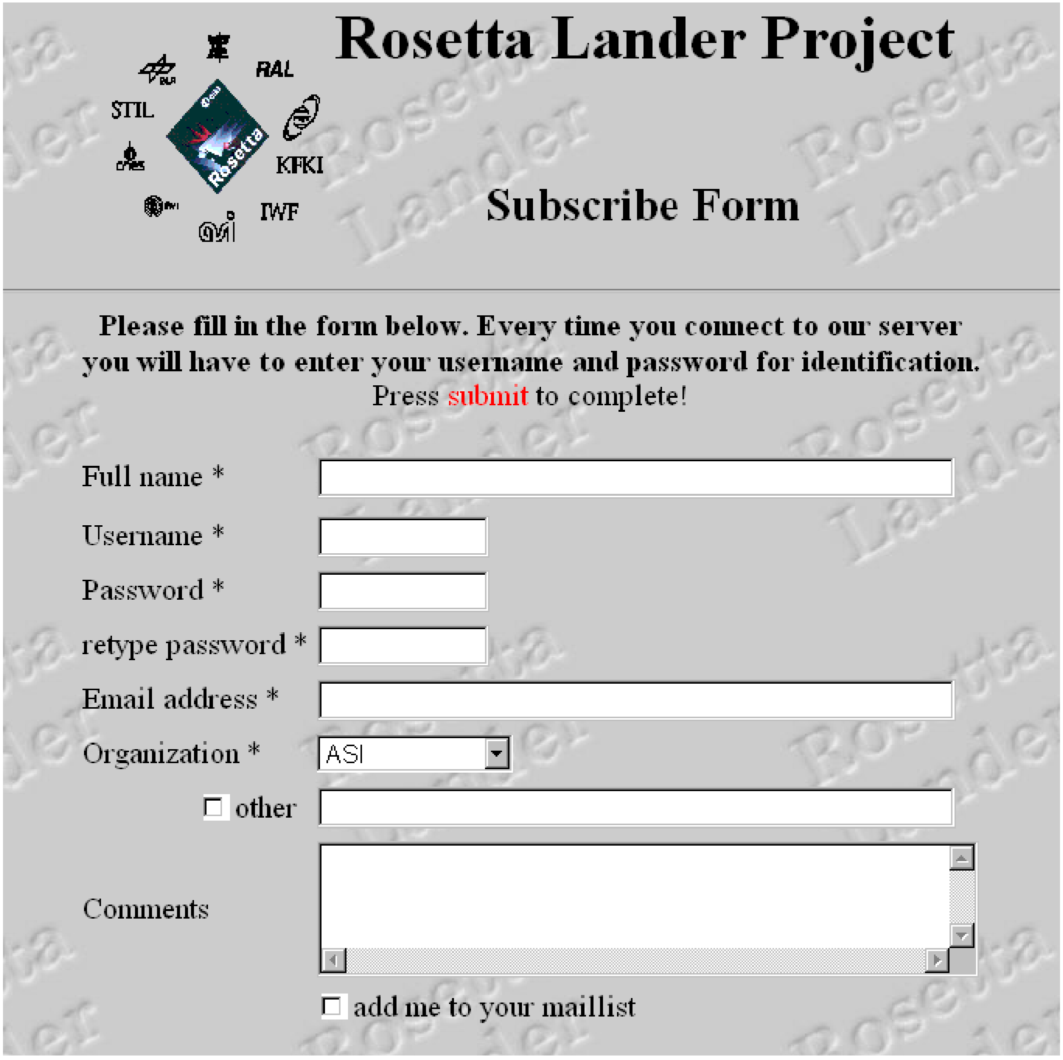


Figure 15-6 Subscription form

Make sure to check the box at the bottom of the form to be notified by email of any changes to our site.

Once your account has been established we will send a notification mail to the email address you gave us during the registration. Attached to that email is a list of all the sections inside the database you now have gained access to. If, for any reason, you are not completely satisfied with that allocation, don't hesitate to drop us a few lines!

Figure 15-7 Forgot your password?

15.4.2 Forgot your password?

You don't have to contact the webmaster at all, if you just have forgotten your password! Have a look at Figure 15-7. Besides the link to our database and another one guiding you to the registration form, we have added a link to a page where you can request your password yourself (see Figure 15-8). For security reasons you will have to submit your User-ID and your email address that you used when you registered!
Upon a successful request, email will be sent to you containing the missing password.

Figure 15-8 Request a missing password

15.4.3 Access the database

Not only are registered users allowed to download documents from our private areas, they also have access to our database inside which they can access the project members address book, search the fax repository, browse the list of acronyms, request an official document ID, etc. via a user-friendly WWW-Interface (see Figure 15-9).

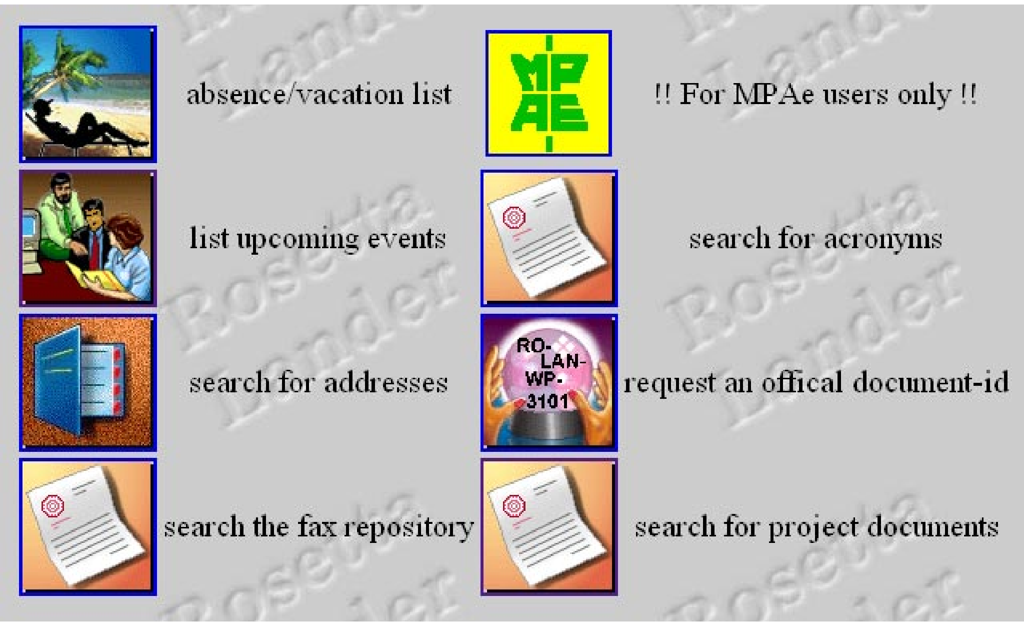


Figure 15-9 Access the database

15.4.4 Configuring the announcement list

Configuration of the mailing list is done automatically by sending email to a dedicated user @ roland.mpae.gwdg.de.

If you want to be notified of any changes to our site without becoming a registered member, send email to

majordomo@roland.mpae.gwdg.de

with the following command in the **body** of your email message:

subscribe rolandnews

If you ever want to remove yourself from our announcement list, you can do it yourself by sending mail to

majordomo@roland.mpae.gwdg.de

with the following command in the **body** of your email message:

unsubscribe rolandnews

If you ever need to get in contact with the owner of the list, (if you have trouble unsubscribing, or have questions about the list itself) send email to
owner-rolandnews@roland.mpae.gwdg.de

15.5 Documents Requirements List

The Experimenter shall provide the following documents:

Document	Document reference
Budgets: - mass - operating power	Are contained in REID-B
Radiation mathematical model	not for instruments
Radiation sensitivity analysis	RO-LAN-AN-3902; inputs from instruments tbc.
Mechanical ICD	Interface to Rosetta: LID-B; inputs from instruments required
Interface structural mathematical model	RO-LAN-AN-3503; on Lander level with inputs from instruments
Structural analysis	RO-LAN-AN-3504; inputs from instruments tbc.
Mechanisms analysis	tbc.
Thermal ICD	RO-LAN-IF-3703
Interface thermal mathematical model	RO-LAN-AN-3705; inputs from instruments tbc.
Test & flight temperature predictions	RO-LAN-AN-3706; inputs from instruments tbc.
Power interface circuits	At present, part of REID-B
Electrical interface circuit analysis	RO-(SUB)-AN-3805
Pyrotechnic interface circuits	RO-LAN-TN-3806
Harness and connector interfaces	RO-LAN-TN-3807
OBDH interface circuits	RO-LAN-TN-3808
Software controlled interface document	RO-LAN-AN-3401
EMC control plan	At present, part of REID-B. To be established on Lander level with subsystem inputs.
Cleanliness control plan	not for CDMS
Product assurance plan	RO-(SUB)-PL-3201

Configuration management and control plan	RO-(SUB)-PL-3202 (part of PA plan)
Non-conformance reports - summary	RO-(SUB)-NC-31xx RO-LAN-LI-3203
Request for waiver	RO-LAN-RW-31xx
FMECA	RO-LAN-TN-3204; inputs from instruments to be discussed with Lander team individually for each instrument
Single point failure list	RO-(SUB)-LI-3205
Critical items list	RO-(SUB)-LI-3206
Hazard analysis and residual hazard sheet	RO-LAN-TN-3207
Parts stress analysis	RO-LAN-TN-3208
Reliability assessment	RO-LAN-TN-3209
Declared materials list	RO-(SUB)-LI-3210
Declared mechanical parts list	RO-(SUB)-LI-3211
Declared processes list	RO-(SUB)-LI-3212
Configuration control plan	RO-(SUB)-PL-3213, maybe part of PA plan
EEE-parts list	RO-(SUB)-LI-3215
Instrument configuration list	RO-(SUB)-LI-3214
Experiment intermediate design review data package	RO-LAN-DP-3102
Experiment final design review package	RO-LAN-DP-3103
Experiment flight operations review data package	RO-LAN-DP-3104
Experiment acceptance data package	RO-(SUB)-DP-3105
Design, development and verification plan	RO-(SUB)-PL-3301
Interface compliance matrix	RO-LAN-TN-3106
Test matrix	RO-LAN-TN-3302 (part of REID-B)
Test procedures	RO-(SUB)-TP-33xx
Functional test report	RO-(SUB)-TR-3xnn, x=4,5,6,7,8,9
Metrology report	RO-(SUB)-TN-3107
Physical properties report	RO-(SUB)-TN-3108
Electrical interfaces verification report	RO-(SUB)-TN-3811
Structural test report	only preliminary test report; applicability is defined by the test matrices
Thermal test report	as defined by the test matrix
EMC test report	RO-(SUB)-TR-3812

Ground operations plan	not for CDMS
Test and flight control procedures	RO-(SUB)-PR-34nn
MGSE user manual	RO-LAN-PR-3403
Experiment operation requirements	RO-(SUB)-RD-3404 (part of REID-B)
Experiment data operation handbook	RO-(SUB)-PR-3405
Experiment user manual	RO-LAN-PR-3406
Lander product tree	RO-LAN-HM-3109
Master network	RO-LAN-HM-3110
Monthly progress report	RO-LAN-RP-3111
Lander (sub-) system specification	RO-(SUB)-SP-3101
REID-A	RO-LAN-RD-3111
REID-B	RO-(SUB)-SP-3111

(1)„SUB“ stands for documents which should be established by each instrument and subsystem. Documents identified by „LAN“ shall be established on Lander level based on inputs from instruments and subsystems.

(2)This list is based on the EID-A, section 8 requirements. In the course of the project, some documents might be added.

(3)The above documents which are written subsequently within the course of the project, shall become later part of the Acceptance Document Package which shall be delivered for each deliverable model (qualification, flight and flight spare).

16 LIST OF FIGURES

17 LIST OF TABLES