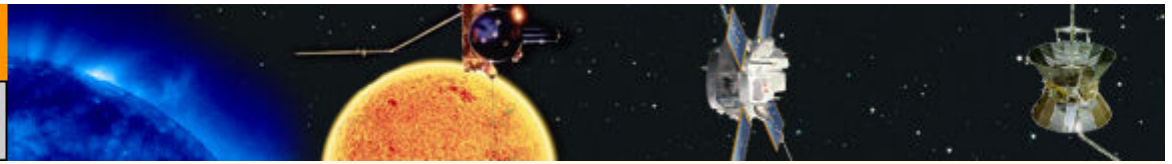
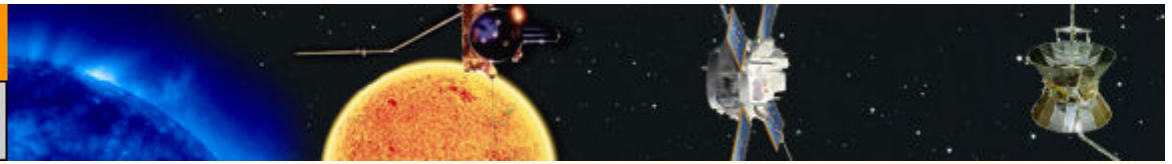


IRAS Mechanical Design Overview

Author

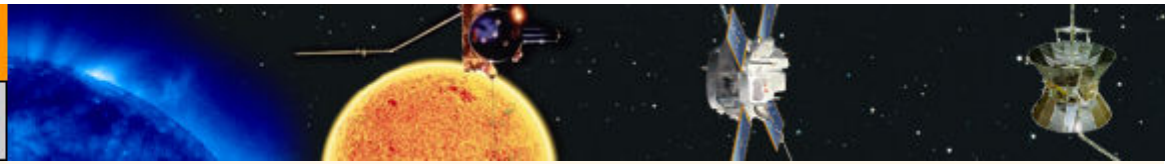
Lars Seimetz,

Mechanical Engineer IRAS/ CAU



Content

- Design Requirements
- CAD-Design Snapshots
- IRAS MICD
- Mass Estimation
- Design Details
  - IRAS Telescope
  - Electronics Accommodation
  - Integration Scheme
- Structural/ Thermal
- Conclusions
- Next Steps
- Backup Material



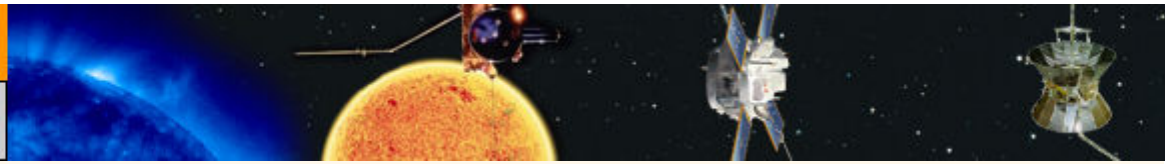
Mechanical Design Requirements I

- The IRAS Instrument has to meet the design requirements as defined in *EXM-PL-ICD-ESA-00004, Issue 1, Rev.0: (TBC)*, e.g.:
  - Instrument Mass: 500g in total.
  - Requirement from BED → Mounting from top
  - Design needs to correspond with dynamic envelopes (BED) of oth. instr.
  - Thermal Requirements

Temperature range	Design		Acceptance (and start-up)		Qualification	
	Min	Max	Min	Max	Min	Max
Non-operative temperature	-50 °C	60 °C	-55 °C	65 °C	-60 °C	70 °C
Operative temperature	-40 °C	50 °C	-45 °C	55 °C	-50 °C	60 °C

Table 6-3 Temperature ranges for internally mounted equipment

„Temperature ranges internal instruments 17-06-08.doc"



Mechanical Design Requirements II

- Thermal Environment: TBD
- Magnetic:
  MagGuidelinesShort_v2 (→MSMO EXM-MSMO-PL-DTU-6203)
- Shock/ Vibration:
  - Excerpt from *EXM-PL-ICD-ESA-00004, Iss.1, Rev.0, 6.2.2.1 Design Loads*
- Planetary Protection [PP]:
  - Design has to meet ESA's PP-Requirements *(EXM-MS-PL-ESA-00005, I3, Rev.0)*
  - Design Approach: Reduction of spore density due to clean integration and dry heat cleaning for complete instrument avoids necessity of hermetic sealing.

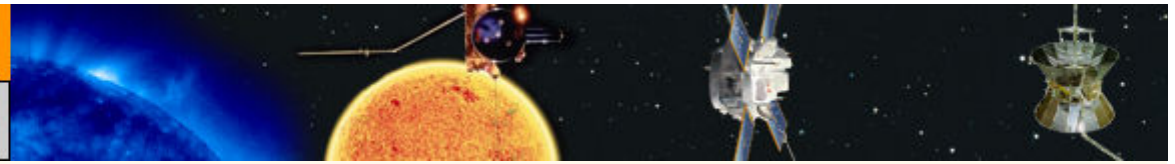
Lander design load factors

LANDER UNITS	DLF (X) [G'S]	DLF (Y) [G'S]	DLF (Z) [G'S]
PCDU	19.5	11.5	11.5
RADAR DOPPLER	27	39	39
GEP/HPL	21.5	25	25
BATTERY	23	15	15
CDMU	25	17	17
RU	25	24	24
OTHER EQUIPMENTS:	DLF (X) [G'S]	DLF (Y) [G'S]	DLF (Z) [G'S]
FROM 0.0 TO 0.5 KG	60	40	40
FROM 0.5 TO 1.0 KG	50	35	35
FROM 1.0 TO 1.5 KG	40	30	30
FROM 1.5 TO 2.0 KG	40	30	30

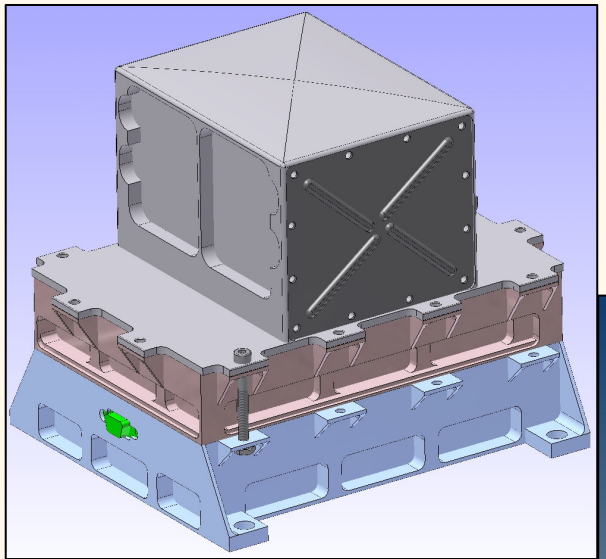
Note: For all Lander installed items the DLF load of 40g due to the landing impact in any direction has to be considered.

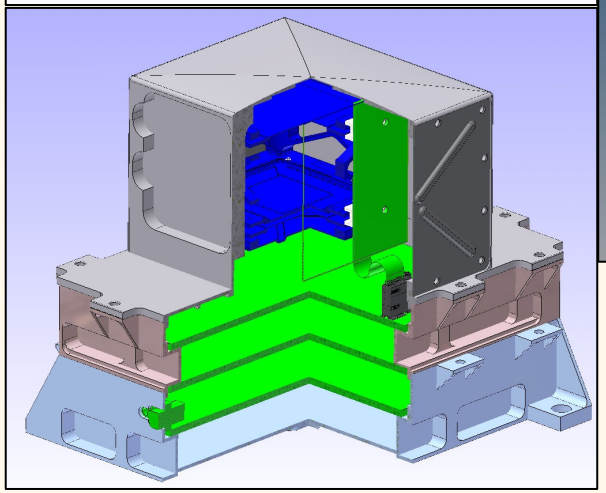
For more detailed information refer to the document [NR 9] EXM-MS-SSR-AI-0004, section 5.

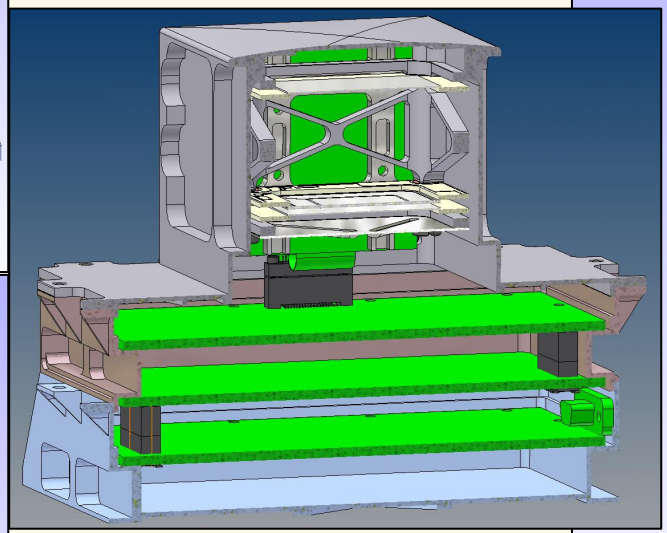
Reference: EXM-PL-IRD-ESA-0002 Iss.: 2, Rev.: 0, (HPL-ENG-ALL-0890)

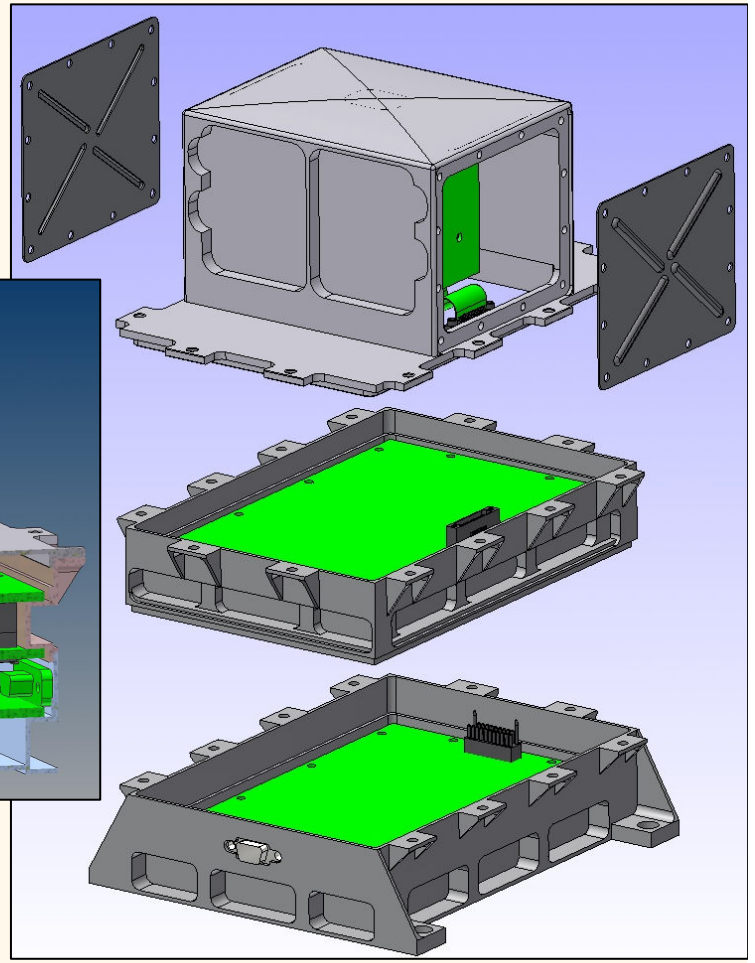


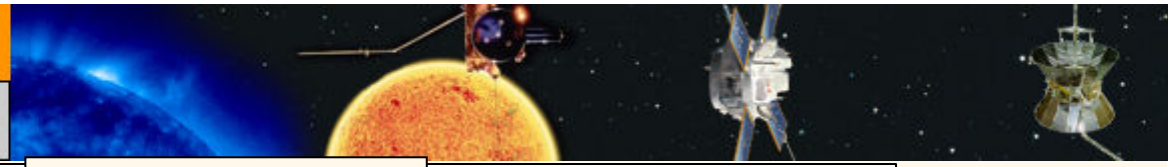
Snapshots IRAS CAD-Design



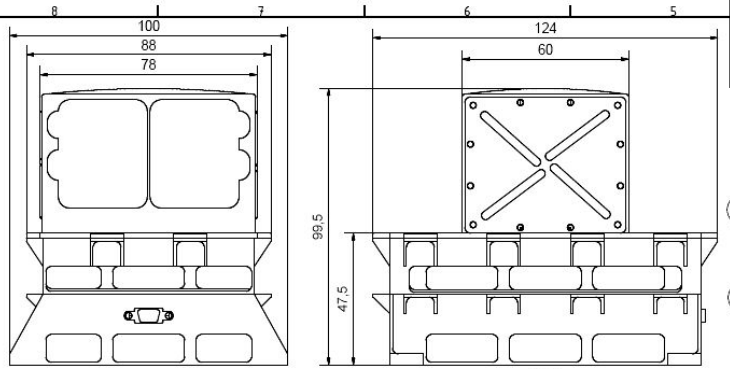


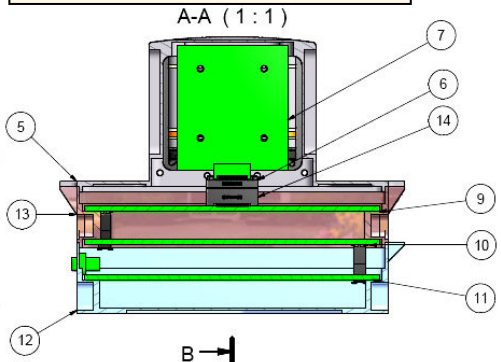


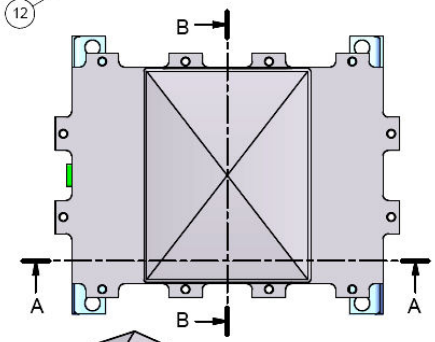


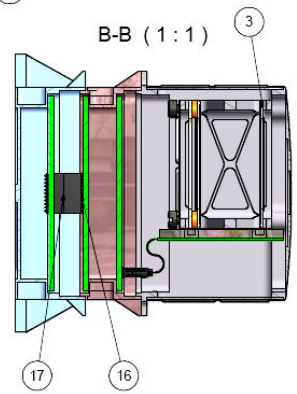


IRAS MICD







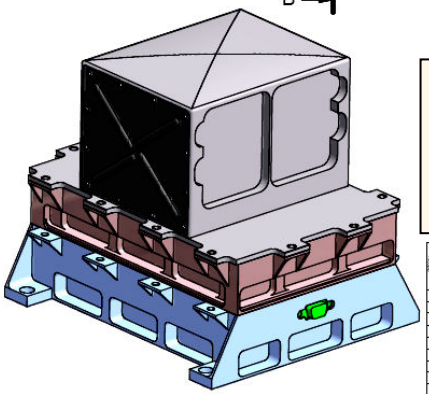


- Footprint:112x100(*mm)
- Silhouette 124x100 (*mm)
- Borehole Pattern:
  - 97x88 (*mm)
- Height: 99,5mm

Parts List

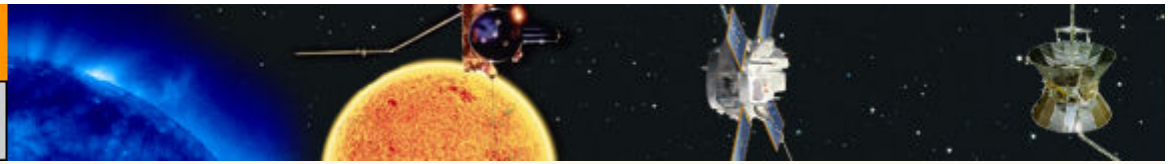
ITEM	QTY	PART NUMBER	TITEL
1	1	exo-iras-01-ish_top	Top Assembly
2	1	exo-iras-04-telescope_top	IRAS Telescope Top Assembly
3	3	exo-iras-02-detector_top	IRAS Detector Top Assembly
4	2	exo-iras-01-2180-00-ls	side-face
5	1	exo-iras-01-2181-00-ls	cover-plate
6	1	a28300-037	Omnetics Bi-Lobe
7	1	exo-iras-06-2188-00-ls	ish_if-board
8	1	exo-iras-05-idpu_top	IRAS Data/ Power Unit Top Assembly
9	1	exo-iras-05-2182-00-ls	analog-board
10	1	exo-iras-05-2183-00-ls	digital-board
11	1	exo-iras-05-2184-00-ls	power-board
12	1	exo-iras-05-2186-00-ls	power-section
13	1	exo-iras-05-2185-00-ls	data-section
14	1	a29200-037	Omnetics Bi-Lobe
15	1		Cannon_MDM-9P
16	2	DRP-20-VV-GS-1-11	Omnetics
17	2	DRS-20-VV-GS-1-11	Omnetics

Anmerkungen/ Notes:



- Mechanical Tolerances TBD
- Document controlled by DLR

Christian-Albrechts-Universität zu Kiel -IEAP- Institut für Experimentelle und Angewandte Physik
Allg. Toleranzen nach DIN 2768
Toleranzklasse: Oberfl.,
Gewicht: 0,246 kg
Date Name
Drawn 06.11.2008 Seimetz
Checked
Standard
IRAS Top Assembly
Zustand: InBearbeitung
Status: pre PDR
Projektion nach DIN 6-1 (E)
exo-iras-00_top.iam
REV: R00
Seite: 1 von: 1
A2

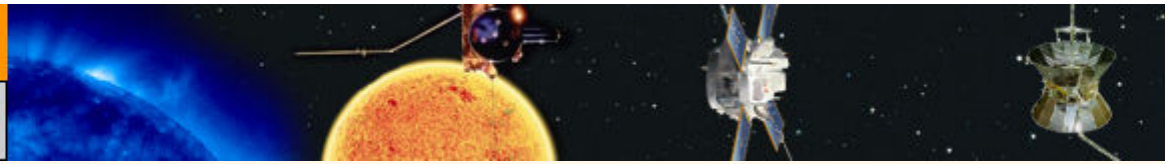


Mass Estimation (CBE)

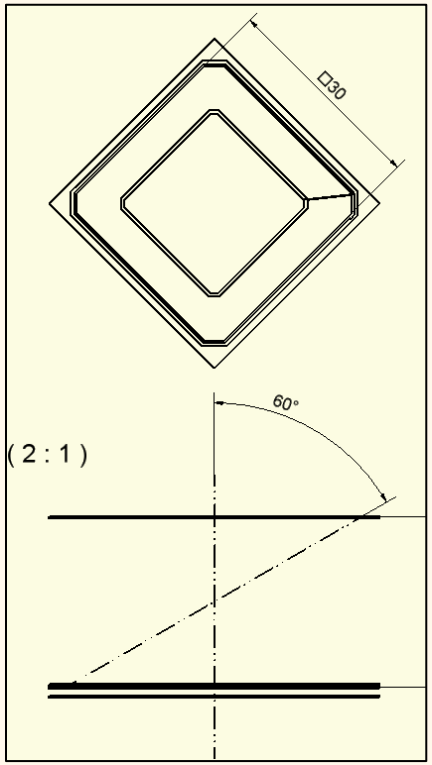
PRELIMINARY

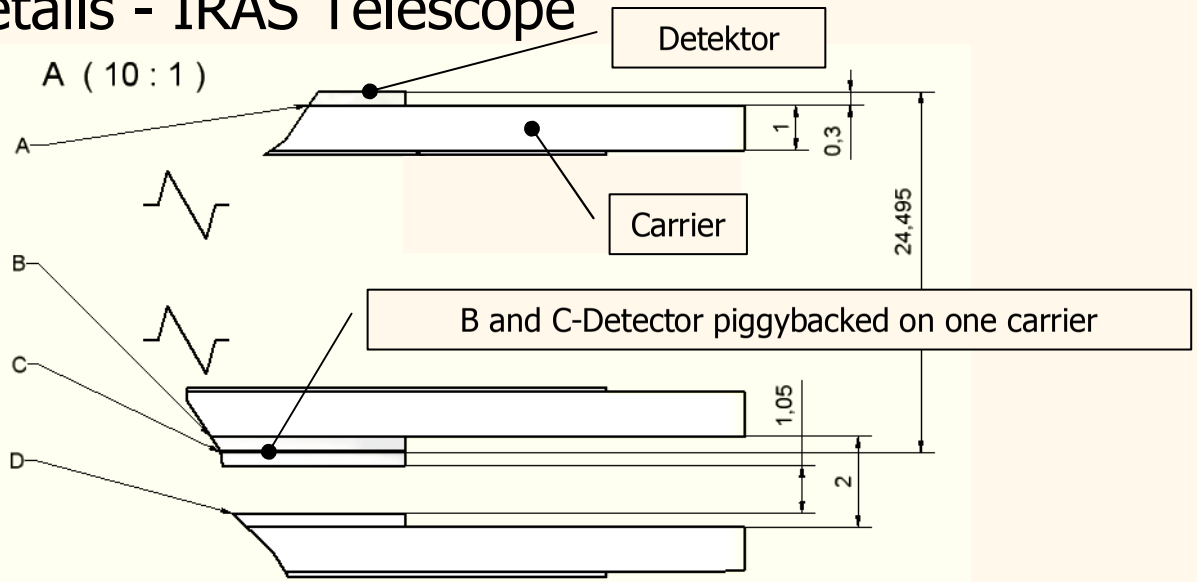
Component	Material (20081107)	Mass CBE [g], Date:20081107 (EXcluding Contingency, Sum for multiple entries)	Contingency [%] based on Design Margin Requirements Policy (Ch. 6.1.6, EXM-PL-ICD-ESA-00004,1,Rev.0) (All group cont. values rounded to full %)	Total (g) (INcluding Contingency)
IRAS				
ISH (IRAS Sensor Head)		**168**	**19%**	**200**
ISH Telescope		59	18%	70
ISH Housing		60	20%	72
ISH-IDPU Interface		19	20%	23
Rest Sensor Head		30	20%	36
IDPU (IRAS Data and Power Unit)		**320**	**19%**	**380**
IDPU Housing		109	17%	128
IDPU Electronics Components		211	20%	252
Total IRAS		**488**	**19%**	**581**

- Magnesium for main hous. parts (Alloy TBD):
  - Baselined Material AZ80AF is rated „low corrosion cracking resistance" (Table3: ECSS-Q-70-36A)
  - No experience with ESA-preferred M1A, etc. alloys
- Wall thickness ~1mm, FEM validation open
- CBE per 20081107
  - 488g, excluding contingency
  - 581g, including 19% contingency

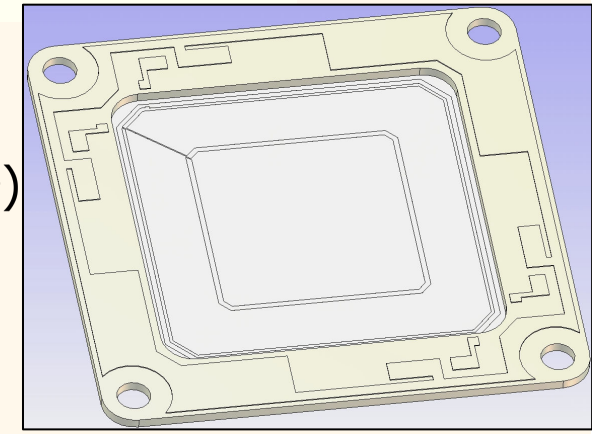


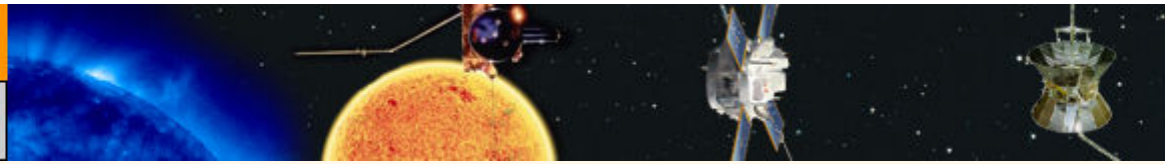
Design Details - IRAS Telescope





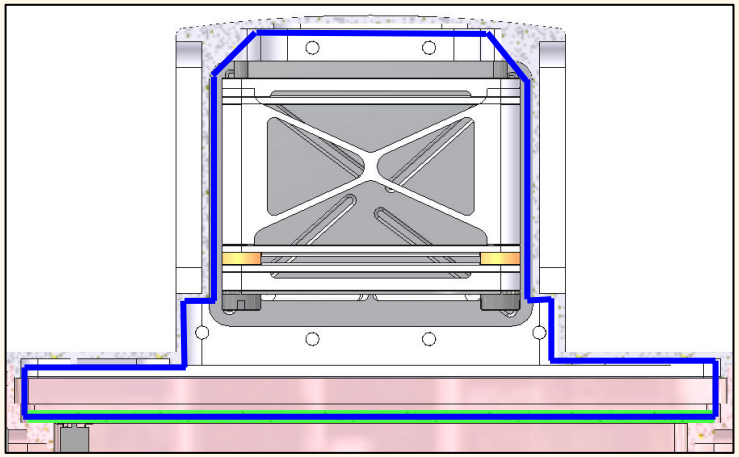
- 0,3 mm Si Detectors
- Manufacturer: CANBERRA
- Carrier Material/ Thickness 1mm (TBD)
  - Al2O3 or AlN
- FOV Half-Angle 60°
- Strain-Relief directly behind solder joints on carriers



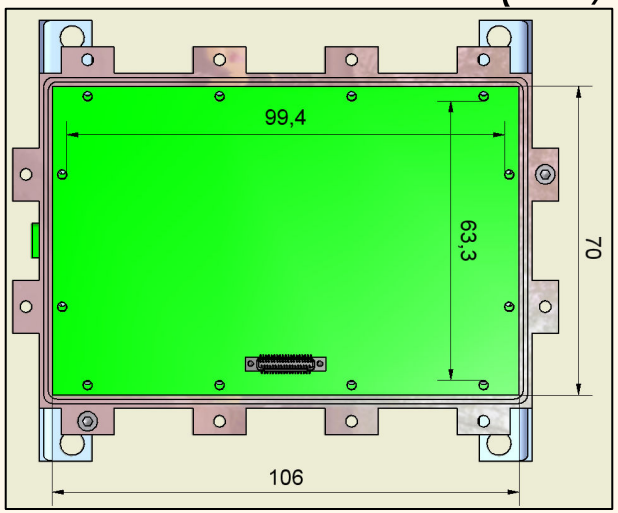


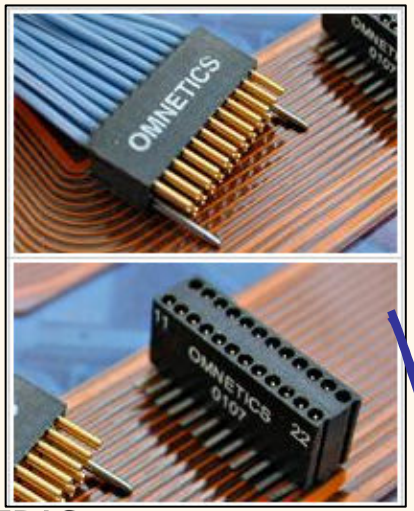
Design Details – IRAS Electronics

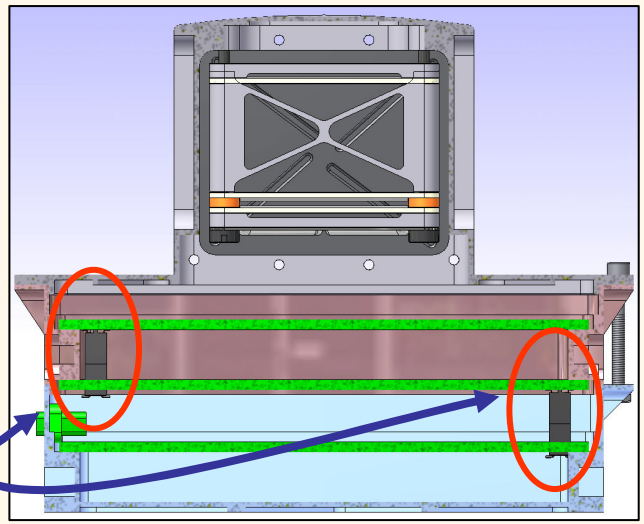
- Board Dimensions: 106 x 70 (*mm)
- Shielding concept of Telescope:
  - Revolving grounding contact area on each PCB
  - Multilayer Boards: Intermediate shielding layer with VIAs connecting to contact face

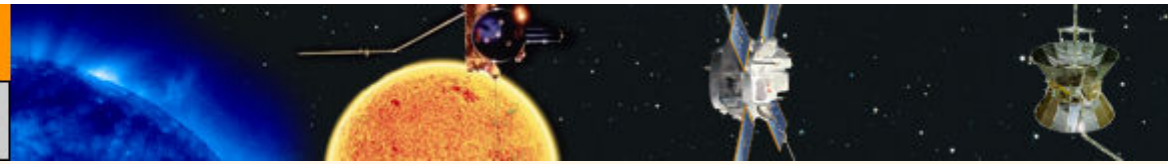


- Interconnection planned with pitch connectors, e.g.
  - *Omnetics MICRO (DRS/DRP) , Omnetics Bi-Lobe*









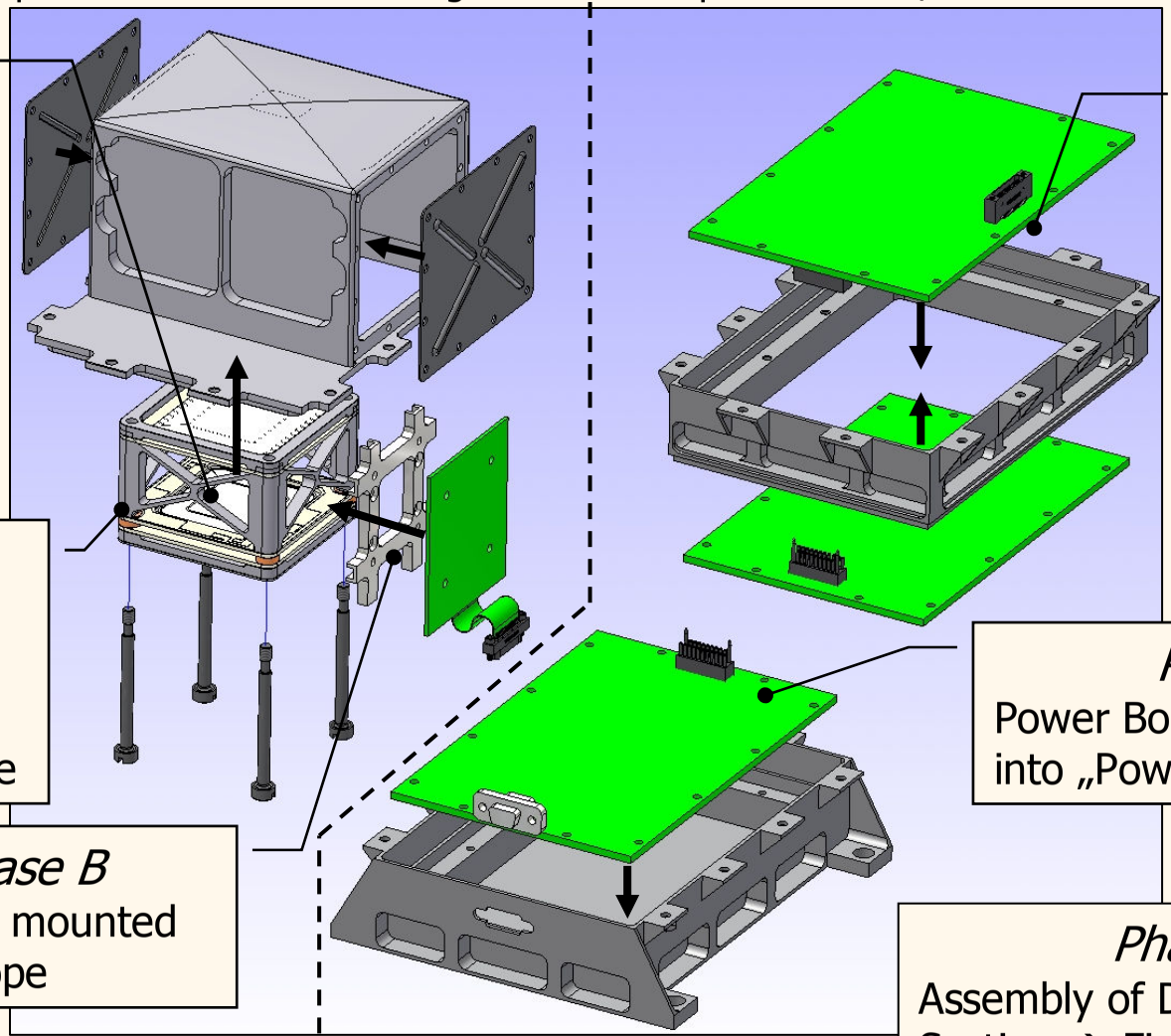
Design Details - IRAS Integration Scheme

Independent Sensor Head Integration | Independent Data/Power Unit Integration

Phase C
Once finished, telescope is mounted into top-cover → Finishing IRAS Sensor Head [ISH]

Phase A
4 IRAS-Det. assembled to separate telescope-package

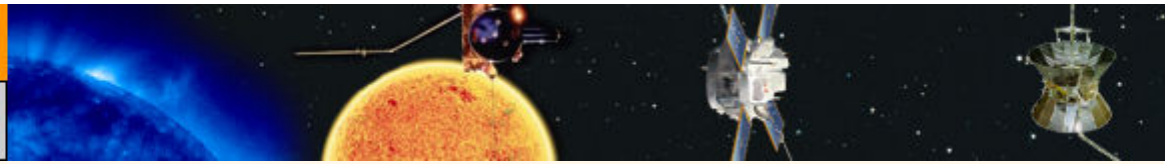
Phase B
I/F Board mounted to telescope



Phase A
Analoge and Digital Board mounted into „Data Section"

Phase B
Power Board mounted into „Power Section"

Phase C
Assembly of Data and Power Section → Finishing IRAS Data and Power Unit [IDPU]

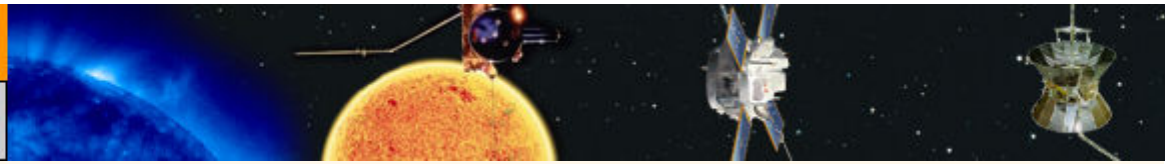


Structural/ Thermal

- Structural and thermal analysis planned to be performed by Procomec, Bertinoro, Italy
  - Heritage in performing thermal analysis for MATROSHKA using NASTRAN structural analysis software.

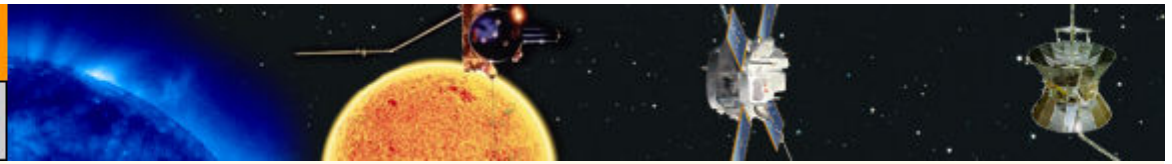
Some Structural/ Thermal points of interest

- Bonding of „Piggyback"-Detector Package BC
  - Find best glueing-pattern to prevent pounding of detectors
- Bearing of Telescope
  - Minimize resulting vibrations of detectors
- Validation of housing design against Exomars mission dynamic loads *(EXM-PL-IRD-ESA-0002 Iss.:2, Rev.:0(TBC))*
- Heat Dissipation of DC/DC Converter and FPGA
- Heating of telescope



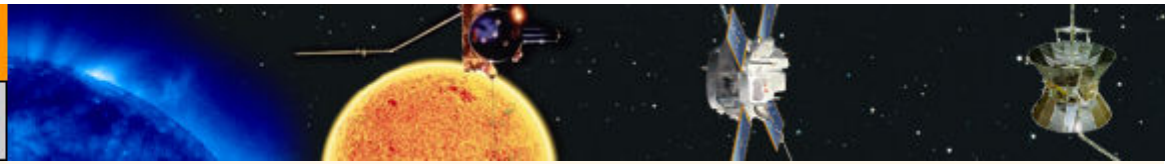
Conclusions

- Current design meets mass criteria of 500g.
  - Use of 15Pin Data-Connector would increase mass
- Design meets technical needs of IRAS team.
  - Validation open
- Design is consisted with BED Design (cross-checked with BED design from Oct.14th, 2008)
  - Can be integrated from top
  - Stays outside dynamic envelopes of other instruments.
- Dry Heat Sterilization feasible
  - (Detectors can not be wiped)

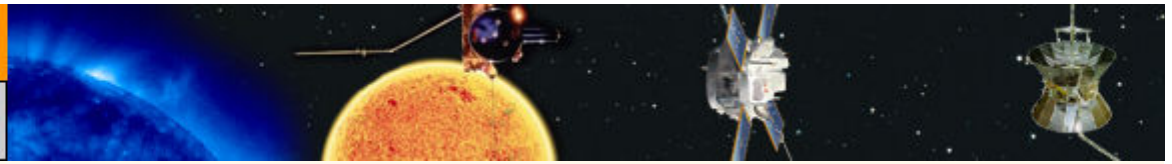


Next Steps

- Initial Test with IRAS GSE, refer to Björn Schuster‘s (CAU) Talk
- Clarify
  - Magnesium Alloy to be used, Availabilty, Lead time
  - Use of „LN“ screws mandatory ? (Availability, Lead time)
  - Required surface treatment of housing
  - Bonding concept for BC detector package
  - Bearing of telescope (Location)
  - Concept of internal venting through PCB-Via‘s feasible ?
  - Type of intermediate connectors for PCBs, Vendor, Availability, Lead Time
- Clarify necessitiy of „Planetary Protection Course“?
  - For which team members
  - When ?



BACKUP MATERIAL



Details Mass Estimation

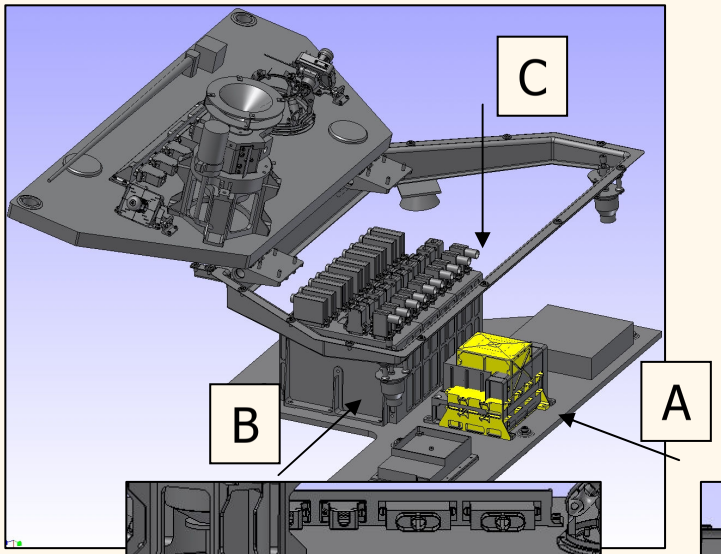
PRELIMINARY

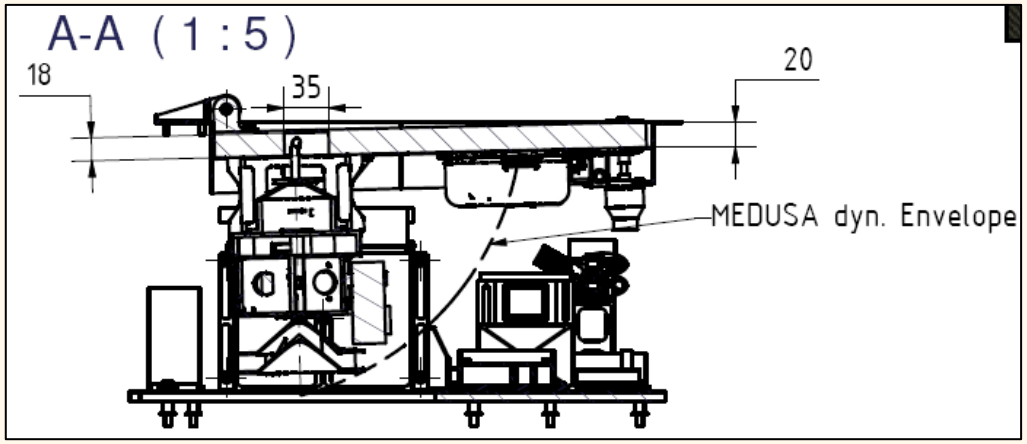
Component	Material (20081107)	Mass CBE [g], Date:20081107 (EXcluding Contingency, Sum for multiple entries)	Contingency [%] based on Design Margin Requirements Policy (Ch. 6.1.6, EXM-PL-ICD-ESA-00004,1,Rev.0) (All group cont. values rounded to full %)	Total (g) (INcluding Contingency)
IRAS				
ISH (IRAS Sensor Head)		**168**	**19%**	**200**
ISH Telescope				
exo-iras-02-detector_top.iam (4x)	Si/Al2O3	13	10%	14
exo-iras-04-2176-00-ls_telescope-core	AL	11	20%	13
exo-iras-04-2178-00-ls_telescope-terminator (2x)	AL	8	20%	10
exo-iras-04-2179-00-ls_det-shield	AL	3	20%	4
exo-iras-04-2175-00-ls_spacer_det-cd (16x)	POM	6	20%	7
exo-iras-04-2174-00-ls_compliance-washer_det-bc (4x)	AL	6	20%	7
exo-iras-04-2177-00-ls_telescope-screw (4x)	St	12	20%	14
ISH Housing				
exo-iras-01-2181-00-ls_cover-plate	MG	52	20%	62
exo-iras-01-2180-00-ls_side-face (2x)	Al	8	20%	10
ISH-IDPU Interface				
exo-iras-06-2188-00-ls_ish_if-board	n/a	15	20%	18
exo-iras-06-2187-00-ls_if-board-carrier	Al	4	20%	5
Rest Sensor Head				
screws (16x)	St	14	20%	17
Cabling RG178, (16x)	various	16	20%	19

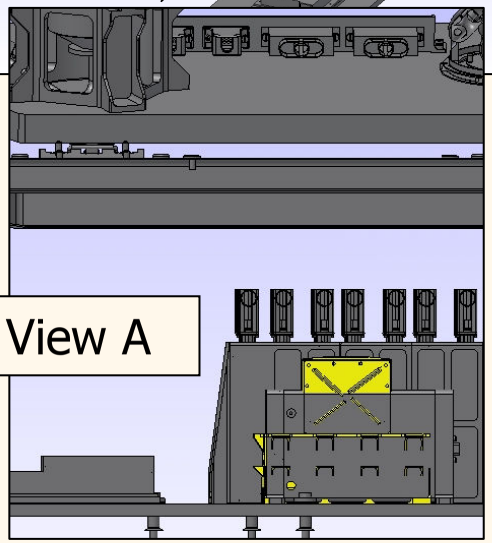
- Magnesium for main hous. parts
- 0,8mm<=Wall thickness<=1mm
- CBE per 20081107
  - 488g, excluding contingency
  - 581, including 19% contingency

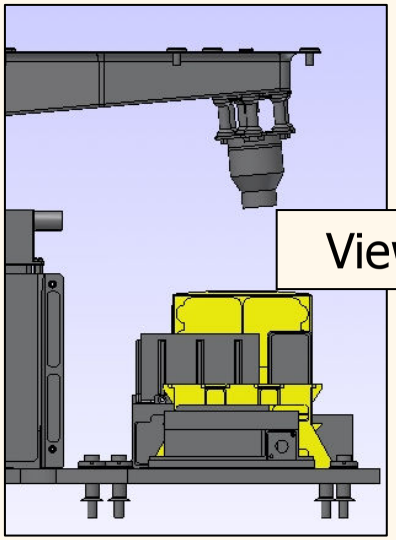
IDPU (IRAS Data and Power Unit)		**320**	**19%**	**380**
IDPU Housing				
exo-iras-05-2186-00-ls_power-section	Mg	52	20%	62
exo-iras-05-2185-00-ls_data-section	Mg	29	20%	35
Screws	St	28	10%	31
IDPU Electronics Components				
PCBs (Analogue, Digital, Power)	n/a	163	20%	196
screws	St	10	10%	11
MDM15 (Data to HUMBOLDT)	n/a	10	20%	12
MDM 9 (Power to HUMBOLDT)	n/a	10	20%	12
Omnetics Connectors (I/F ISH to IDPU, I/F Ana.-Dig, I/F Dig.-Pow.)	n/a	18	20%	22
Total IRAS		**488**	**19%**	**581**

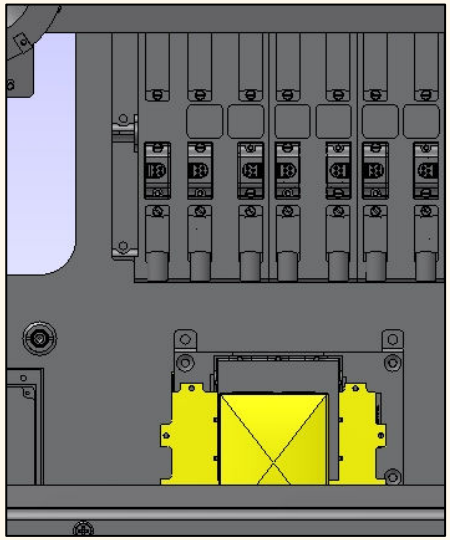
Accommodation of changed IRAS-Design on BED

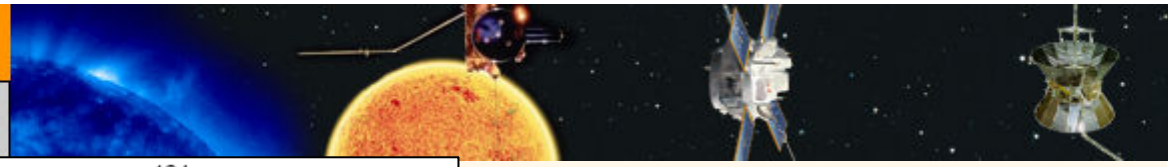




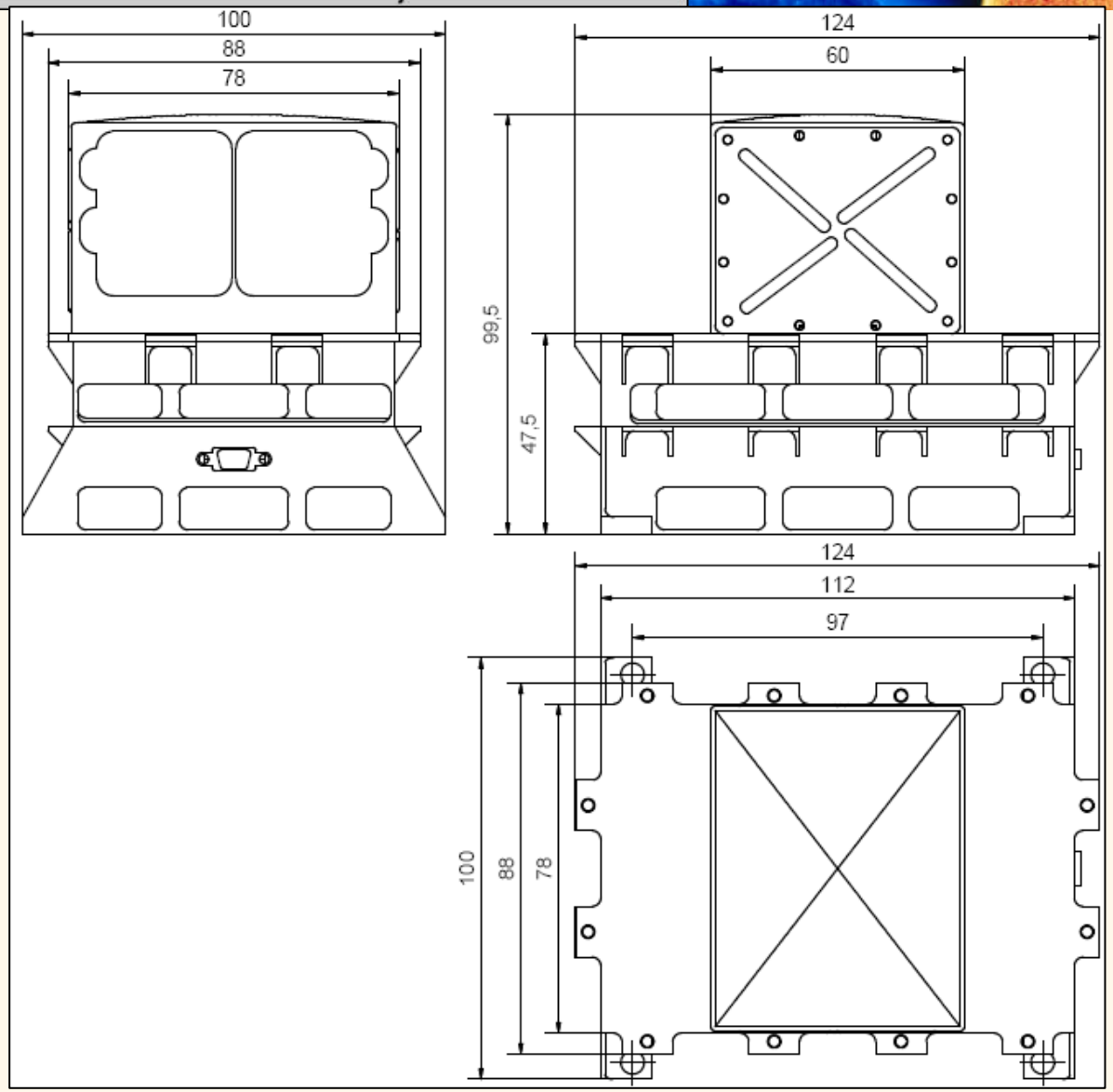




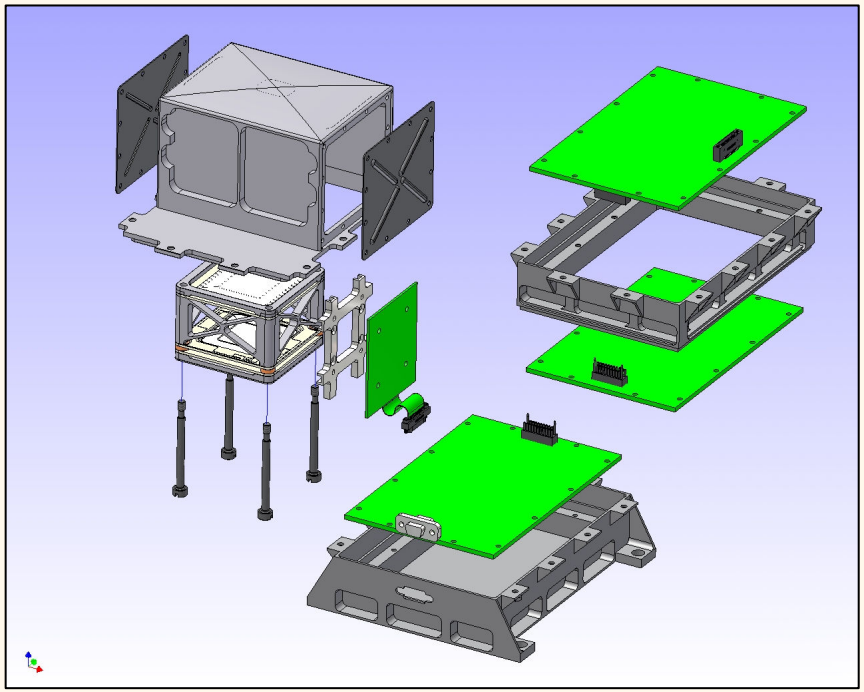


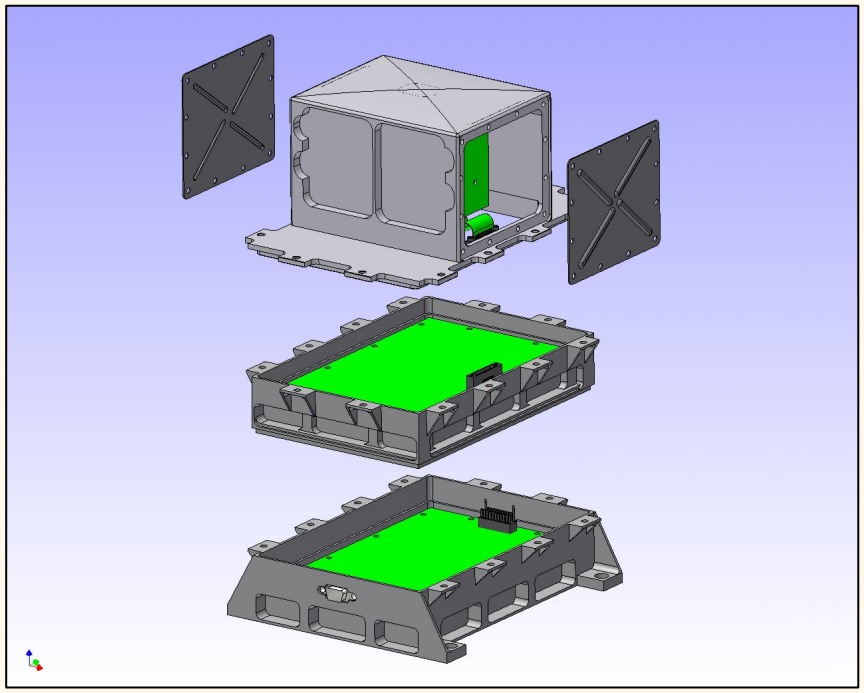


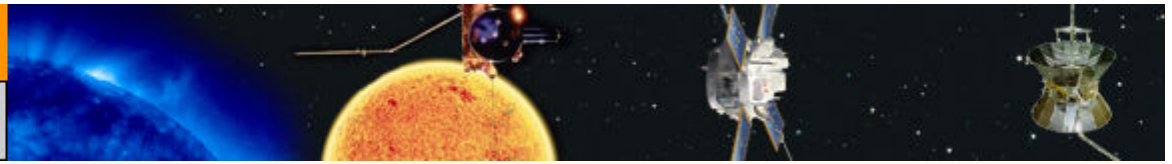
IRAS MICD



More Snapshots







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