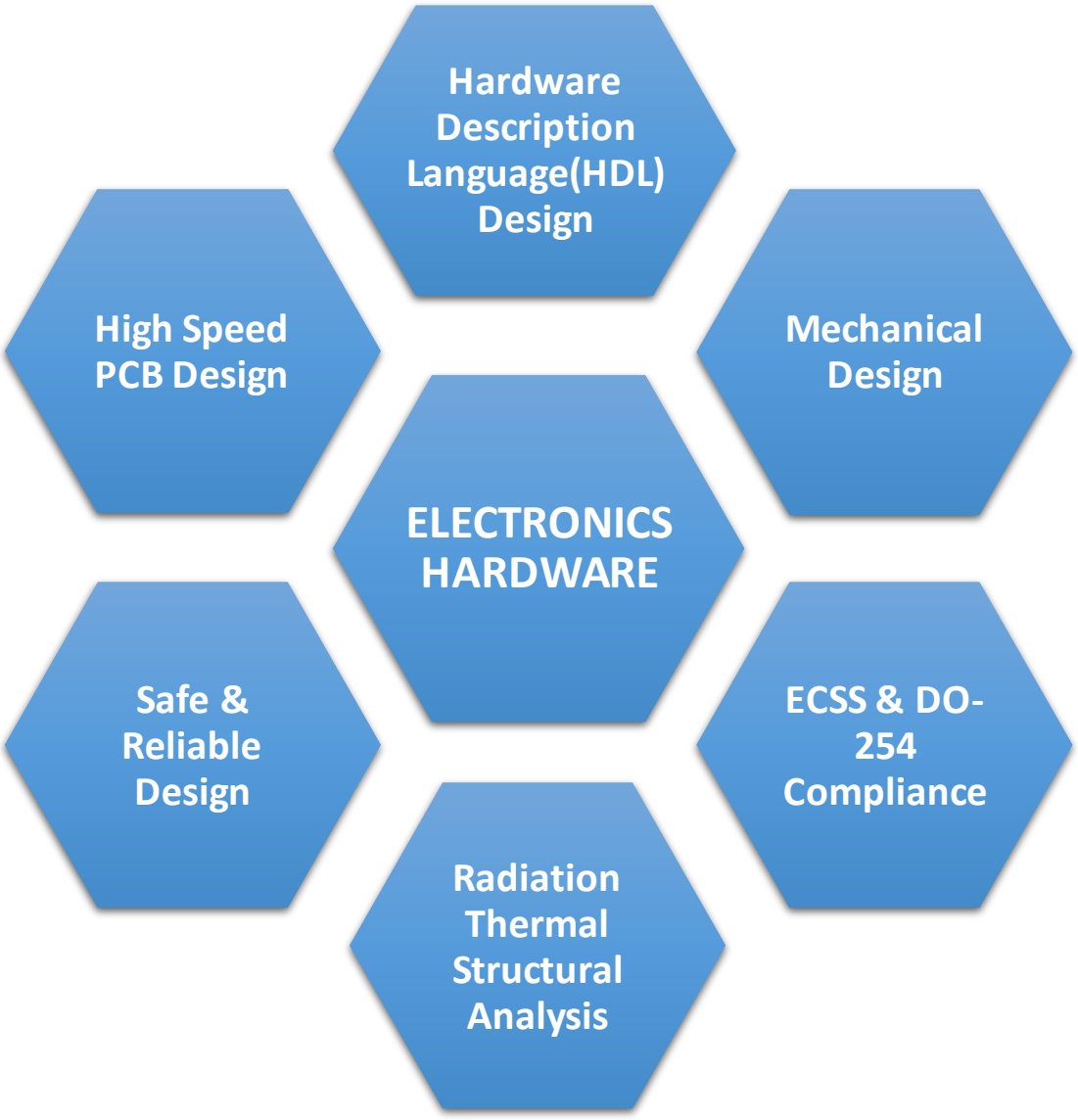
SPACE SYSTEMS

SATELLITE EQUIPMENT & HARDWARE

SPACE SYSTEMS HARDWARE DESIGN COMPETENCIES



ATTITUDE AND ORBIT CONTROL INTERFACE UNIT

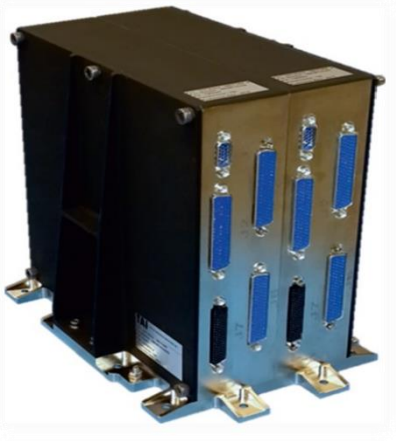
GÖKTÜRK-2 Altitude and Orbit Control System:

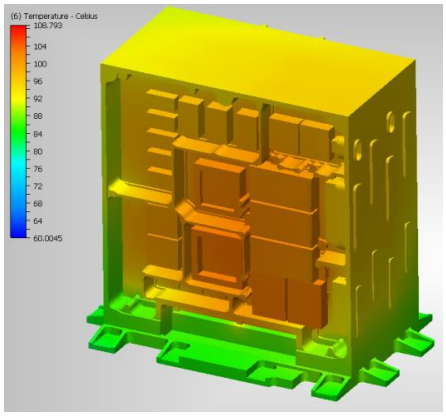
- >8 Years LEO flight heritage (GÖKTÜRK-2)
- Radiation Tolerant Design

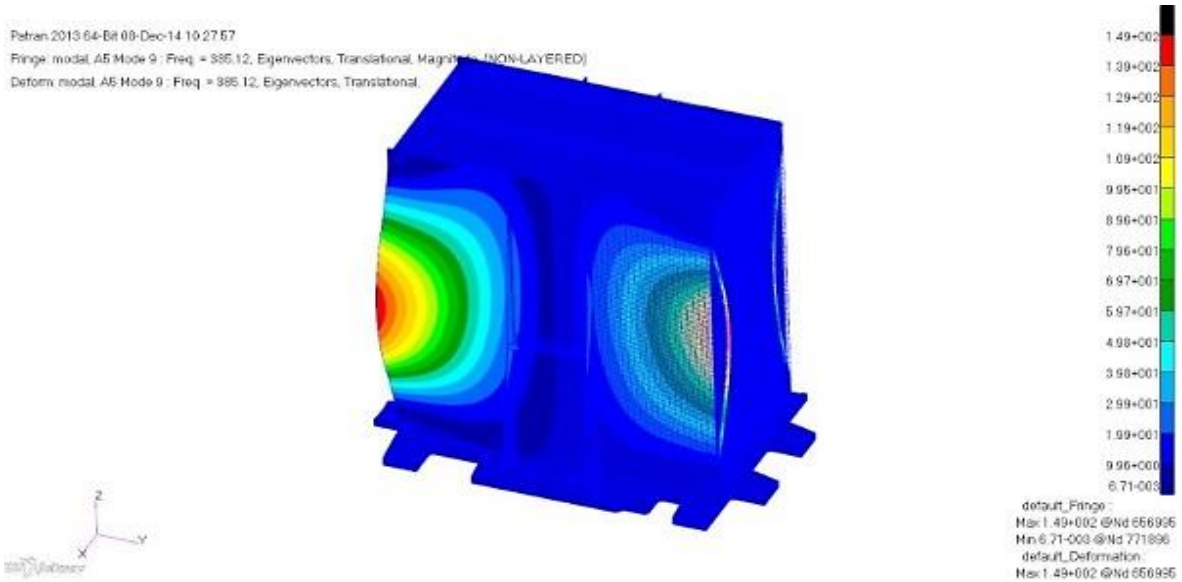
Satellite Platform	LEO/GEO Satellites
Main Bus Voltage	• 28V DC Input
Communication Interface	• CAN (Dual redundant)
AOCS Interfaces	• 2+2 Fine Sun Sensor • 2+2 Magnetometer • 3+3 Magnetic Torquer
Other External Interfaces	• 0-5V Analog Inputs

ON BOARD COMPUTER (OBC)

- SPARCV8 LEON3-FT Core processor
- CCSDS Compliance Hardware Based TM and Direct TC
- Cross-Strapped Redundant Architecture (SAVOIR)
- Hardware Based Error Correction -EDAC, RS, TMR
- On Board Time Management
- Hardware Based Reconfiguration
- Redundant Data Buses (MIL-STD-1553B, CAN, SpaceWire)
- RS422, RS485, LVDS
- ECSS Compliant Discrete Interfaces, BDM, BSM, HPC
- 52 DMIPS@ 64 MHz
- 320 Mbit MRAM
- 12 Gbit SDRAM
- 64 Gbit NAND Flash
- Power Input : 28V or 100V
- Power Cons. : 23W @ 64 MHz
- Mass : <5,5 kg
- Volume : 158 x 256 x 230 mm

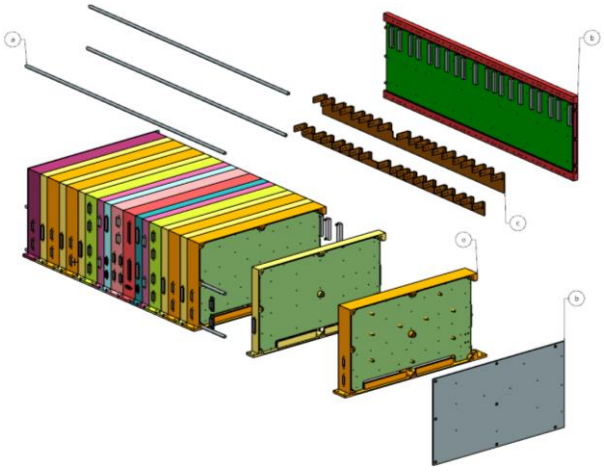


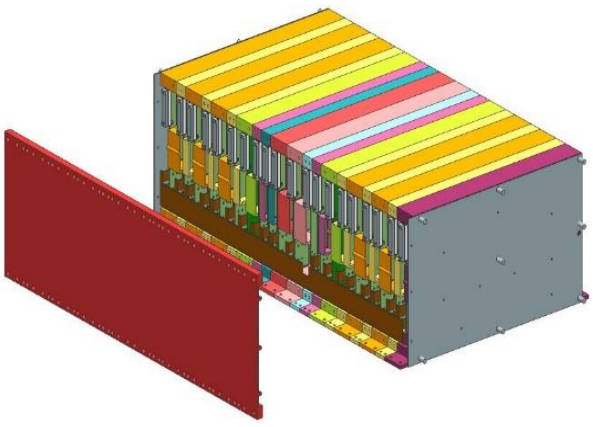




POWER CONTROL AND DISTRIBUTION UNIT (PCDU)

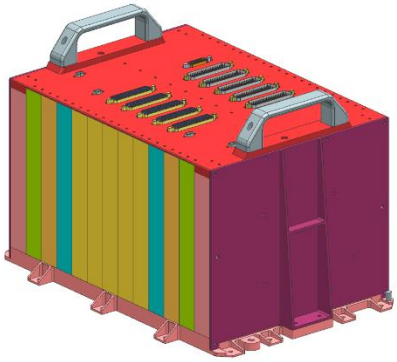
Target Platform	GEO Telecommunication Satellites
Main Bus Voltage	100,5V ± 1V
Main Bus Output Power	10,8 kW
Solar Panel Power Capacity	12 kW
Solar Panel Unit Quantity	24
Battery Technology	Li-ion
Controlled Battery Blocks	2
Battery Capacity	115 Ah (Each Battery)
Battery Charging Current	Max 4,4A (Each Battery)
Battery Charging Range	54V ~ 84V (Each Battery)
Battery Management	Autonomous
Battery Management Method	Constant Current/Constant Voltage
Power Converters Efficiency	• Solar Panel Regulator > 98 % • Battery Charge Regulator > 92 % • Battery Discharge Regulator > 95 %
Power Converter Protections	Resettable Internal Protections
Main Bus High Voltage Protection Level	110V
Communication Interface	MIL-STD-1553B and ECSS Compatible Discrete Interfaces (BDM, BSM, HPC)

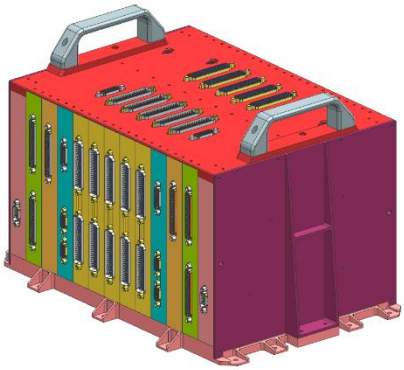




PLATFORM INTERFACE UNIT

- Full – Autonomous Hardware Based Design
- RTG4 FPGA Based Design
- Redundant Architecture
- Hardware Based Error Correction (EDAC, TMR, Scrubbing)
- 3 – Level Safety Barrier For Thruster İnterfaces
- TID > 50 Krad, SEU Effects Mitigated by Design, SEL LETth > 60 MeV.cm2/mg



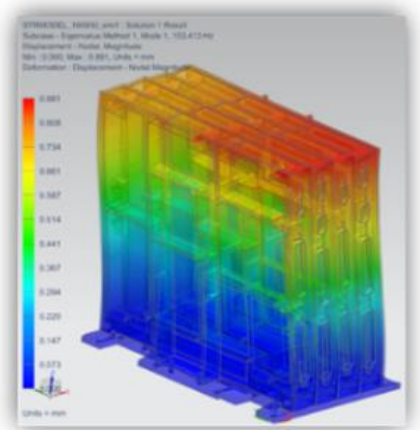


Target Platform	LEO/GEO Satellites
Main Bus Voltage	• [+22V,+37V] DC Input for LEO • +100V DC Input for GEO
Communication Interface	• MIL-STD-1553B • CAN • SBDL • UART-RS422
AOCS Interfaces	• 8+8 Coarse Sun Sensor • 2+2 Magnetometer • 3+3 Magnetic Torquer • 4+4 Reaction Wheel
Thruster Interfaces	• 8+8 Flow Control Valve • 2+2 Latching Valve • 3+3 Pressure Sensor 28V DC Power Output • 3+3 Pressure Sensor Analog Inputs
ECSS Compatible Discrete Interfaces	• BDM Inputs • BSM Inputs • ASM Inputs • TSM Inputs • HPC Inputs • HPC Outputs

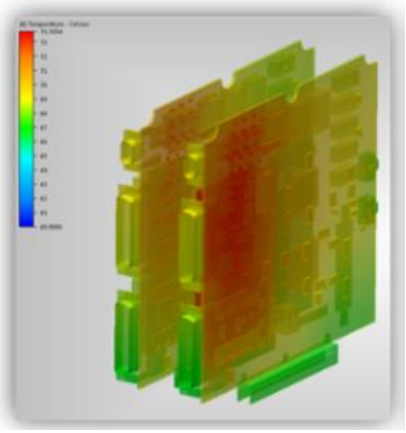
Other External Interfaces	• 12 Thermocouple Inputs • ± 5V Analog Inputs
External Synchronization Input	• 2+2 RS-422 • Synchronization Period: Programmable (Default 100 ms) • AOCS Sensor Acquisition Interval < 3 ms
Mass	• 14 kg ± 1.5kg (5 x Standard Interface Module Configuration) • 12 kg ± 1.5kg (4 x Standard Interface Module Configuration)
Dimentions	295*401*220.5 (mm)
Non Volatile Memory	MRAM 1 Mbit (128k x 8)

HARDWARE DESIGN & VERIFICATION

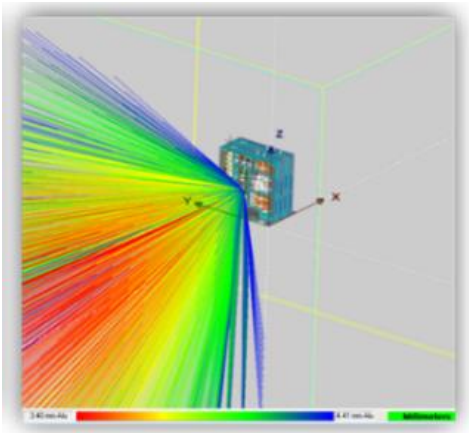
- **THERMAL, RADIATION AND STRUCTURAL ANALYSIS**



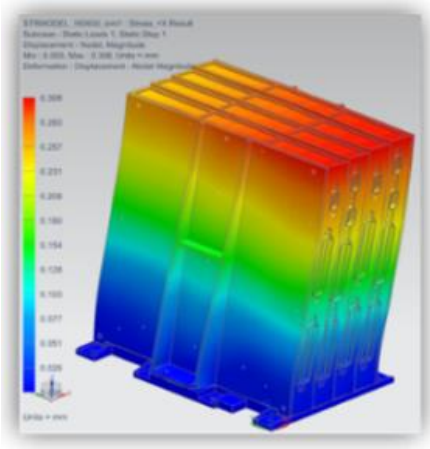
Natural Frequency Analysis

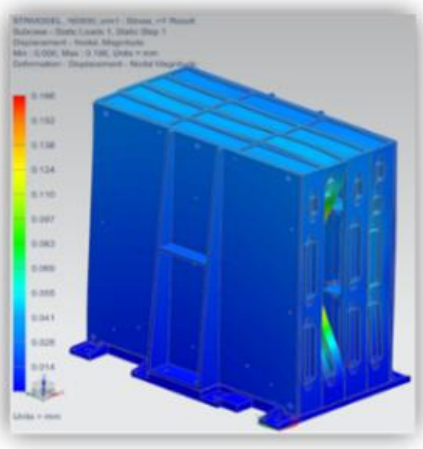


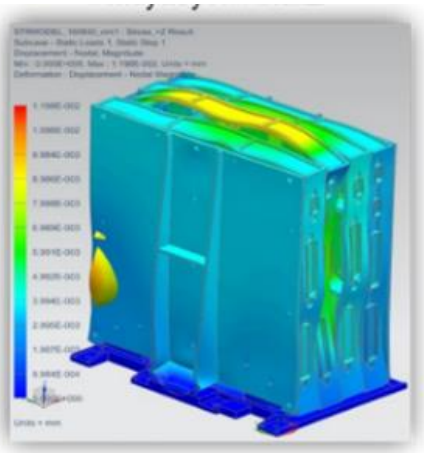
Thermal Analysis



Radiation Analysis







Structural Analysis

ELECTRONIC HARDWARE INTEGRATION

Electronic Hardware Assembly Laboratory

- **ELECTRONIC HARDWARE ASSEMBLY**

YAMAHA SCREEN PRINTER

TRI-SPI
(SOLDER PASTE INSPACETION)

I-PULSE M20
(PICK AND PLACE)

ITRI-AOI
(AUTOMATIC OPTICAL INSPECTION)

IBL VAC 745
(VACUUM VAPOR PHAESE OVEN)

PVA DELTA 8
(DISPENSING SYSTEM)

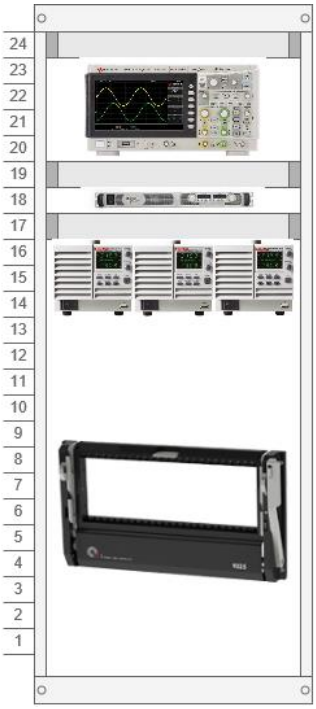
YAMAHA HYBRID PLACER I-CUBE II (DIE BONDER)

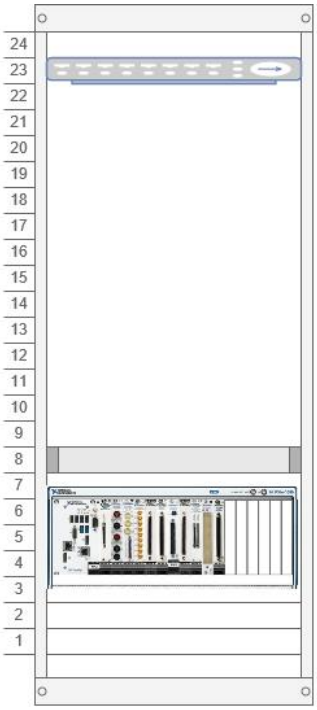
HESSE BONDJET BJ855 (WEDGE BONDER)

GE X-RAY COMPUTED TOMOGRAPHY

ELECTRONIC HARDWARE TESTS

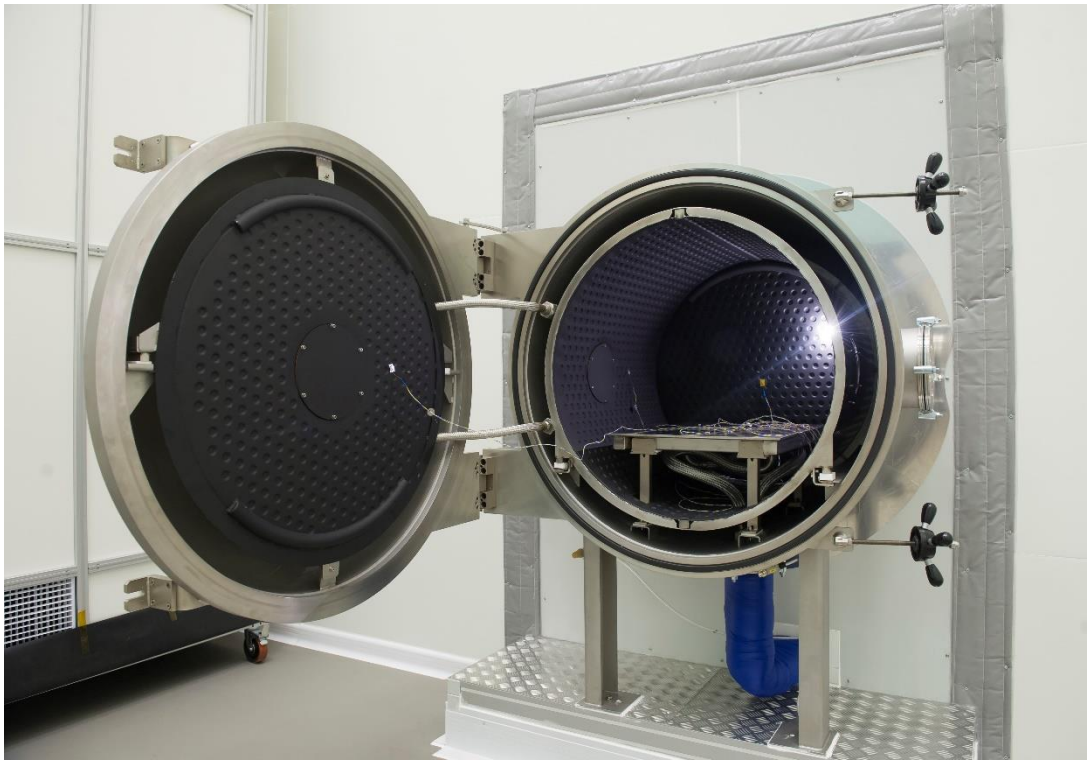
- **AUTOMATED TEST EQUIPMENTS DESIGN**





- **ELECTROMAGNETIC COMPATIBILITY TESTS**

- **EQUIPMENT LEVEL THERMAL VACUUM TESTS**



- **MECHANICAL TESTS**