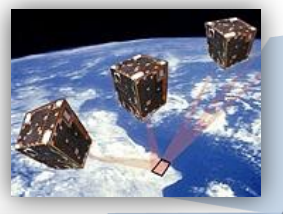
Spacecraft Electrical Power

SITAEL

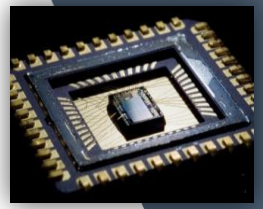
Company Overview



Systems
- Microsatellites

Sub-Systems
- Small instruments
- Sensors and Detectors
- Electric Propulsion (HET, FEEP)
- AOCS

Equipments
- Spacecraft Electrical Power
- Control Electronics for Complex Systems
- Spacecraft Data and Communications
- Electrical Ground Support Equipments



Microelectronic Devices
- Rad tolerant Analog, Digital and Mixed-Signal ASICs
- Digital IP Cores for Complex FPGAs

Italian Medium Enterprise with more than **200 high qualified employees** and **state-of-the-art facilities**

Strong Heritage in Design, Development, Production and Qualification of **Instruments, Electronics and Microelectronics Systems** compliant with high reliability standards.

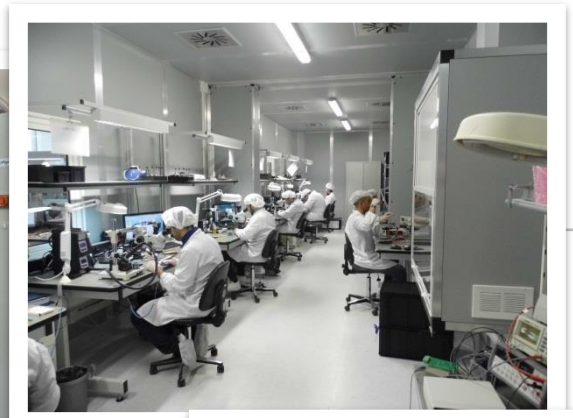
Turn-key **Microsatellites based Solutions for Earth Observation and Science Applications and Services**, with the support of selected partners.

Quality Assurance Certifications: **EN 9100**, ISO 14001, SA8000

SITAEL

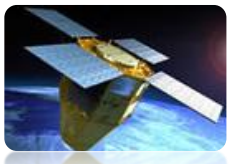
Plants and Facilities

- Headquarters in Modugno (BA) – *Design, Engineering and Production*
- Premises in Pisa – *Design and low volume production*
- 10000 m^2 new Headquarters under construction in Bari



- Qualified production line for space activities
- Large area class ISO 8 Clean Rooms
- Automatic Assembly Line
- Anechoic Chamber
- Mechanical Test Facilities
- Thermal Chamber
- X-Ray Machine

Main Space Programs and Customers


MUSIS CSO

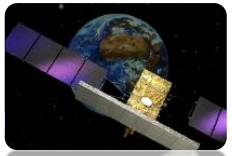

SENTINEL 1


SENTINEL 3


AMS01/AMS02


EarthCARE


SWARM


COSMO 2nd Gen


Curiosity

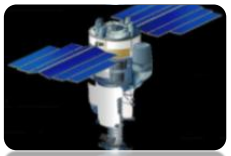

CALET

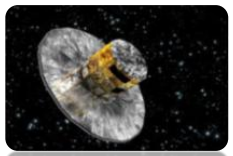

ExoMars


ASTRO-H

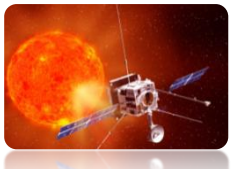

INTEGRAL


Orion MPCV


PAMELA


GAIA


ATV


Solar Orbiter


ASIM


MTG


ICESAT-2

Extensive heritage in a wide range of solutions that have been delivered to the most important Space Players in Europe and all around the world

esa | NASA | JAXA
cnes | ASI | ThalesAlenia Space
Selex ES A Finmeccanica Company | ASTRIUM | OHB CGS
COM DEV | AIR LIQUIDE | ENERGIA
ATMEL | SRON | INFN

SITAEL

Space Electrical Power Overview

SITAEL designs and produces a very wide range of reliable, low noise and high efficiency space-born power supply systems. Power products include the following series: HV, LMV, and Specific Power Supplies.

SITAEL heritage and gained experience in power products includes units on several Earth Observation and Science missions on both manned and unmanned platforms.

Spacecraft Electrical Power

HV series

Up to 12 kV high efficiency high voltage DC/DC converters and linear regulators family

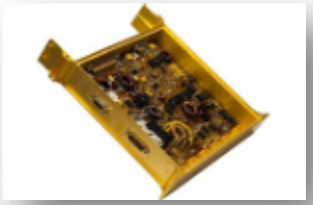
LMV series

From 2.6 up to 120 V space-born high efficiency single and multi-outputs DC/DC Converters

Specific Power Supplies

With over 18 years experienced engineering staff, SITAEL is able to produce space-qualified power supply systems to meet any requirements coming from different satellite payloads and platform sub-systems

- **Optical Payloads (Detectors, Imagers, Spectrometers, APD, PMT, CCD)**
  - Spectrometer Telescope for Imaging X-rays (Solar Orbiter)
  - Soft Gamma-ray Detector, Hard X-ray Imager and Soft X-ray Spectrometer (ASTRO-H)
  - Avalanche Photo Diodes and Photo Multiplier Tubes (CALET)
  - Modular X- and Gamma-Ray Sensor (ASIM)
  - Canadian Electrical Field Instrument (SWARM)
  - JEM-X (INTEGRAL)



- **RF Payloads (SAR, SRAL)**
  - SAR TGU (Sentinel1)
  - SRAL-C Ku (Sentinel3)

- **Data Systems (PDHU, MMU)**
  - MMFU (EarthCARE)
  - PDHU (GAIA)

HV series

High Efficiency High Voltage DC/DC converters and Linear Regulators

- ❑ Up to 12 kV Outputs
- ❑ No Input Single Point Failure
- ❑ Latch-Up Protection Circuit
- ❑ ON/OFF Control
- ❑ Selectable Soft Start and Latch Delay
- ❑ SYNC Input and Thermal protection

DC/DC Converters

Product Code	Input Range	Output Voltage	Output Current
S9031	+26V to +31V	-2500V	2.5mA
S9032	+26V to +31V	-900V	7mA
S9090	+4.75V to +5.25V	+2000V	30uA
S9097	+4.75V to +5.25V	+3000V	100uA
S9098	+4.75V to +5.25V	-3000V	100uA
S9099	+4.75V to +5.25V	+1250V	500uA
S9100	+10.8V to +13.2V	-1250V	500uA
S9102	+4.75V to +5.25V	+1250V	10uA
S9103	+4.75V to +5.25V	+600V	20uA

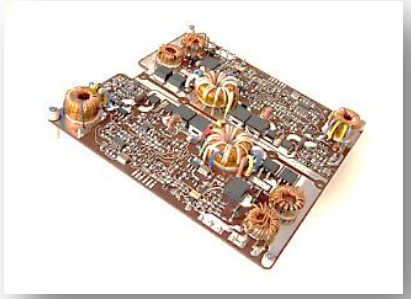
Linear Regulators

Product Code	Input Range	Output Voltage	Output Current
S9033	0V to +2100V	+700V to +1800V	
S9034	0V to -1000V	0V to -950V	
S9035	0V to -2500V	-800V to -2200V	
S9036	0V to +1000V	0V to +950V	

LMV series

Space-born High Efficiency Single and Multi-Outputs DC/DC Converters

- ❑ Outputs from 2.6 up to 120 V
- ❑ No Input Single Point Failure
- ❑ Latch-Up Protection Circuit
- ❑ ON/OFF Control
- ❑ Selectable Soft Start and Latch Delay
- ❑ SYNC Input and Thermal protection



Single Output

Product Code	Input Range	Output Voltage	Output Power
S9008	+22V to +32V	+17 V	100W
S9023*	+26V to +31V	+3.6 V	25W
S9024*	+26V to +31V	+5.6 V	25W
S9026	+26V to +31V	+12V	
(*) Available also in DUAL configuration (two identical modules on a single board for redundancy)			

Multiple Output

Product Code	Input Range	Outputs	Output Power
S9022*	+26V to +31V	+5.6 V; -5.6V	14W
S9027*	+26V to +31V	+3.6V; -2.6V	10W
S9048Dual	+26V to +31V	+2.8V; -2.8V	12W
S9056Dual	+26V to +31V	+5V; +120V	6W
S9074Dual	+26V to +31V	+3.3V; +5.6V	25W
S9021*	+26V to +31V	+5.6V; +2.5V ;-2.5V	15W
S9025*	+26V to +31V	+6V; -6V; +120V	3.5W
S9050 (CPPS)	+22V to +37V	+2.5V; +3.3V; +5V(6x); -5V(2x); +6V; +10V; +12V(2x); -12V; +15V(3x); -15V(3x); +28V(2x)	50W
(*) Available also in DUAL configuration (two identical modules on a single board for redundancy)			

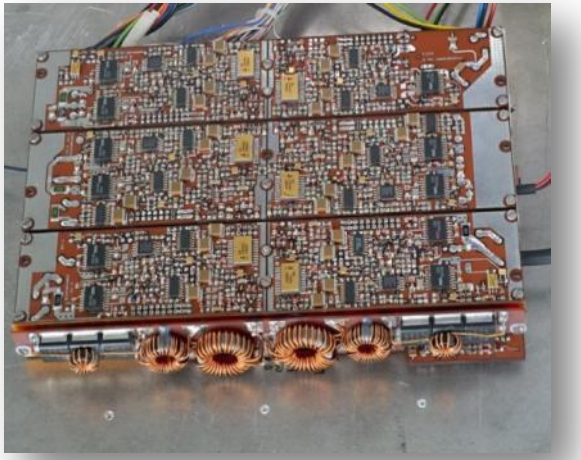
Central Payload Power Supply

Customer: ESA

Function: Central Payload Power Supply for Compact Instrumentation

Features:

- 23 post regulated outputs divided into 10 Instruments groups with independent ground returns
- Output voltages from ±2.5 to ±28 V and current up to 1.5 A.
- Easily adaptable to other secondary supply voltage/current requirements
- Up to 80% efficiency
- 800mW consumption with Instruments OFF
- 22V to 37V Input Bus
- 50W nominal output power
- Load and cross regulation better than 1%
- 100kHz fixed frequency operation
- Low output noise
- Input EMI filter
- Input under-voltage protection
- Overload/short circuit protection
- Output over-voltage latching protection



820 cm³ / 980g

Envisaged for all future ESA small satellite missions

120V/28V DC/DC Converter

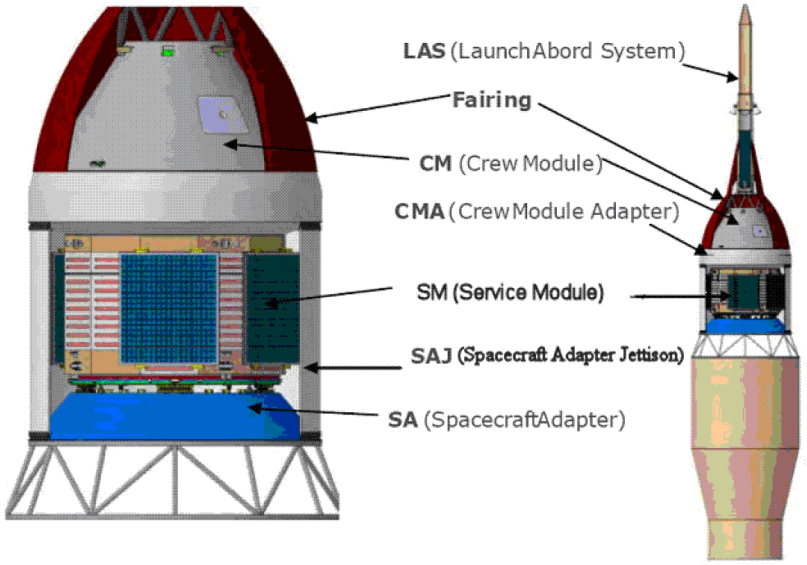
Orion MPCV

Customer: SELEX ES, ASTRIUM DE, NASA

Function: 120V/28V DC/DC Converter Module of the Service Module PCDU of NASA Multi Purpose Crew Vehicle

Features:

- Controls the power flow from 120V Redundant Unregulated Bus to the 28V Regulated Bus inside PCDU
- Two DC/DC modules working in hot redundancy
- Each DC/DC module is composed by two identical sections of Step-down converters, completely independent (apart from the command-decoding interface)
- Two Input Power Bus Capacitors Banks (N+R)
- One Output Power Bus Capacitors Bank
- Max delivered power: 2kW
- 3+1 configuration: 1.5kW reduced power in case of single failure



MPCV Configuration

Specific Power Supplies

With over 18 years experienced engineering staff, SITAEL is able to produce space-qualified power supply systems to meet any requirements coming from different satellite payloads and platform sub-systems, such as

- Optical Payloads (Detectors, Imagers, Spectrometers, APD, PMT, CCD),
- RF Payloads (SAR, SRAL),
- Data Systems (PDHU, MMU),
- Electric Propulsion (Hall, FEEP).

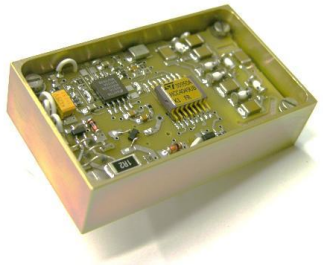
HVPS for Soft Gamma-ray Detector, Hard X-ray Imager and Soft X-ray Spectrometer

ASTRO-H

Customer: JAXA, OHB, ESA

Function: High Voltage Power Supplies (HVPS) to be used in the Soft Gamma ray Detector (SGD), the Hard X-ray Imager (HXI) and the Soft X-ray Spectrometer (SXS) of the ASTRO-H satellites.

Features:



- Power Supply for Si/APD type (HXI, SGD)
  - +600 V / 20uA
- Power Supply for CdTe type (HXI, SGD)
  - +1250V / 10uA
- Power Supply for SXS/MXS (Modulated X-ray Source)
  - -11.3 KV / 50uA
- Common features:
  - Remotely programmable output voltage
  - Low ripple and high output voltage stability
  - Output voltage analog monitor
  - HV enable signal

HVPS for Avalanche Photo Diodes and Photo Multiplier Tubes

CALET

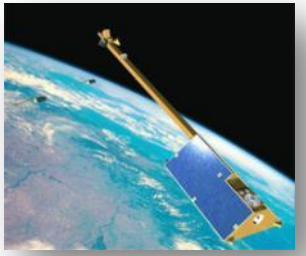
Customer: JAXA, IFAC-CNR, ASI

Function: HV Power Supply Systems for Avalanche Photo Diodes (APDs) and Photo Multiplier Tubes (PMTs) of the Calorimeter Electron Telescope (CALET) Experiment to be installed on ISS Japanese Experiment Module.

Features:

- 22 main + 22 redundant output channels for APDs
  - 0 to +1250 V/ 500 μA
- 80 main + 80 redundant linearly regulated independent output channels for PMTs
  - 0 to -900V / 150uA
- Common features:
  - Remotely programmable output voltage
  - Overcurrent protection on each channel
  - Low ripple and high output voltage stability
  - Output voltage analog monitor
  - HV enable signal

Canadian EFI PSU



SWARM

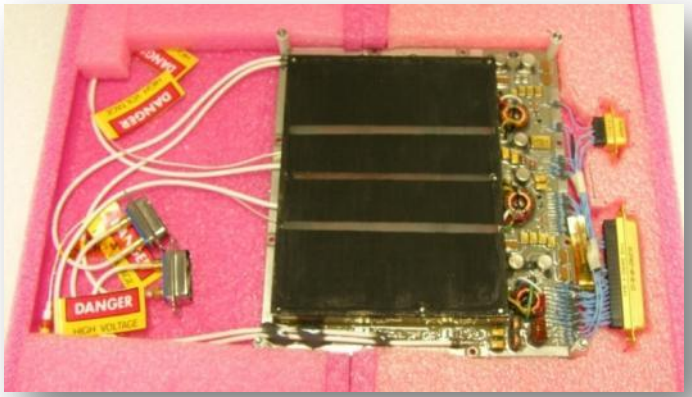
Customer: COM DEV, ESA

Function: Development and MAIT of EM, QM and FM for both Low and High Voltage Power Supply Units of SWARM CEFI

Features:

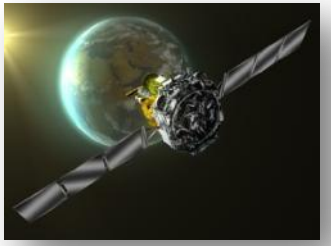
- 6 Low Voltage Outputs: +3.3V, ±5 V, ±15V, +30V
- 8 High Voltage Outputs: double +8KV, double –2.4KV
- double –100V, double AC (–100V ÷ +50V)

LVPS – FM



HVPS – FM

JEM-X HVPS



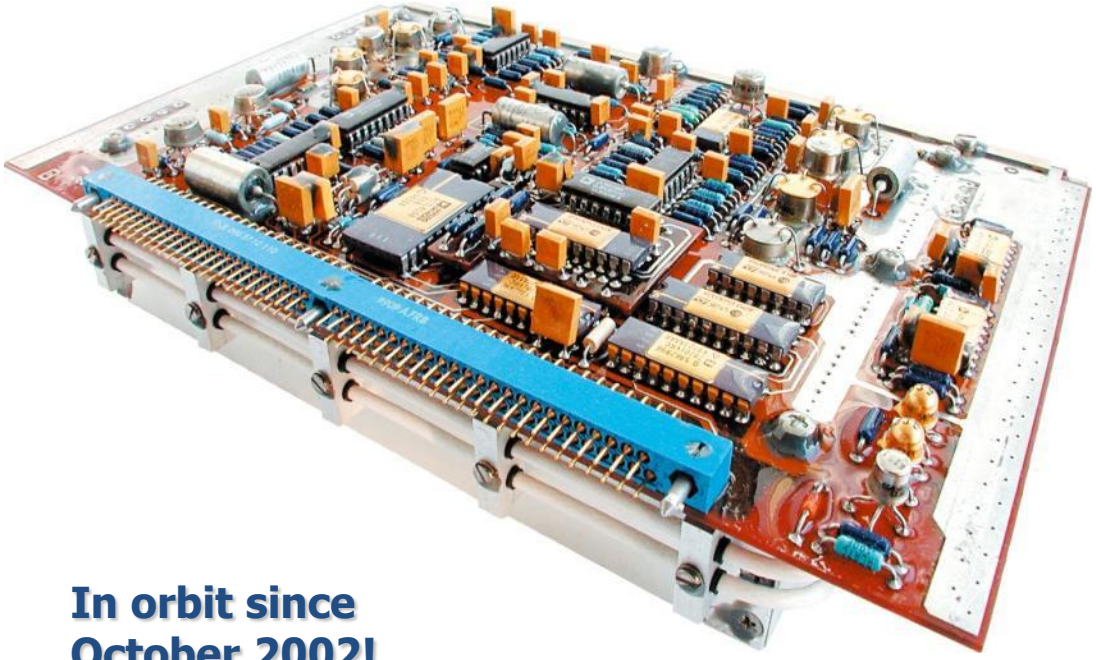
INTEGRAL

Customer: IAS, ESA

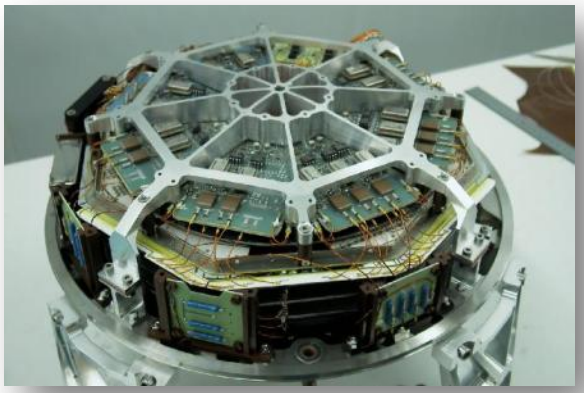
Function: HV Power supply systems for Microstrip Gas Chambers

Features:

- 6 kV @ 30 mA
- floating, programmable
- OvC and OvV protection



In orbit since October 2002!



JEM-X Detector

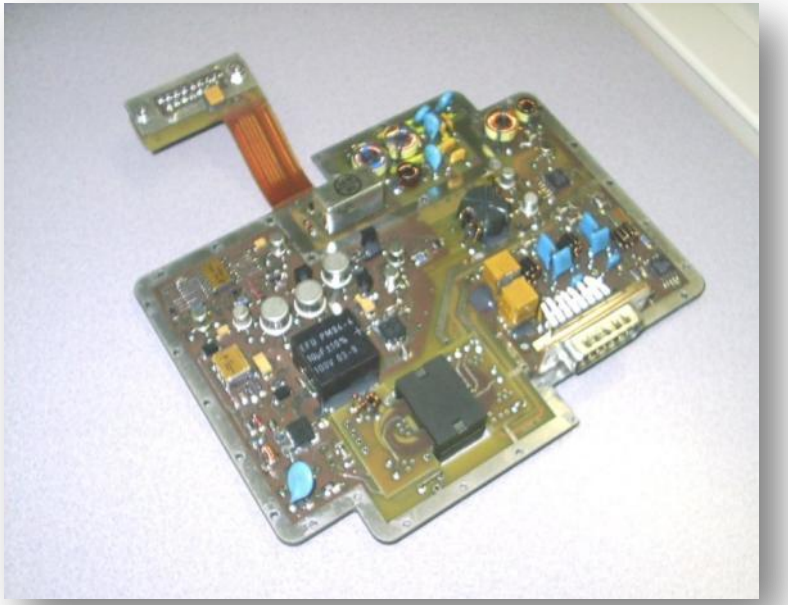
SAMPIF

Customer: ASI, Selex Galileo

Function: Multi-Output Low Power supply for Focal Planes (CCD)

Features:

PARAMETER	MIN	TYP	MAX	UNITS
Input Voltage	24	28	50	V
Output Voltages	4.75 ±14.5 ±31	5 ±15 ±33	5.25 ±15.5 ±35	V
Output Power		2.6	3.4	W
Operating Temperature	-40		+70	°C
Radiation Tolerance (TID)			100	krad(Si)
SEL threshold			75	MeV/mg/cm^2
Isolation resistance	> 10			MΩ
Primary/ground capacitance		6	20	nF



Available at QM maturity

SAR TGU DC/DC

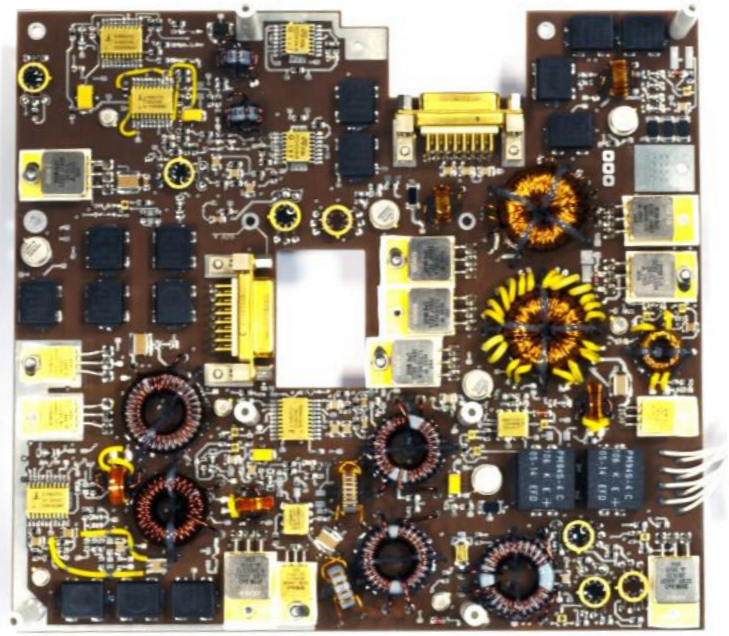
SENTINEL 1

Customer: Astrium UK, ESA

Function: DC/DC Converters for the SAR Transmit Gain Unit on board of ESA Sentinel 1 satellite

Features:

- 28V Input bus
- 6 voltage outputs for an ASIC monitor/contro circuit and a RF Pulsed Power Amplifier.
- 42W maximum output power.



SRAL RFU DC/DC

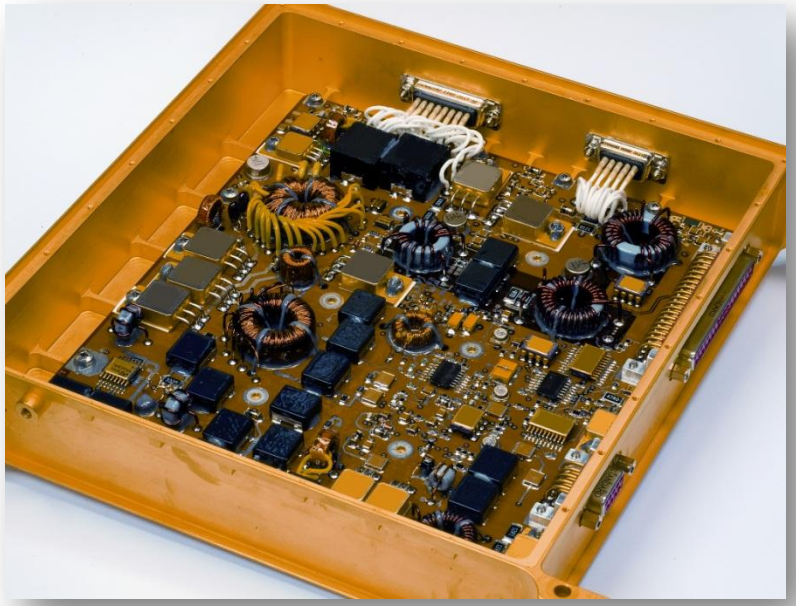
SENTINEL 3

Customer: Thales Alenia Space

Function: DC/DC Converter for the SRAL-C Ku (SAR Radar and ALtimeter) Radio Frequency Unity (RFU) of ESA Sentinel 3 satellite

Features:

- 6 output voltages to the RFU
  - +5V, +6V and -6V regulated,
  - +6.2V, -40V and +30V not regulated
- latching output overload protections
- short circuit protections
- input current monitor
- temperature telemetry



GMES, EC-ESA joint initiative

MFFU PSB

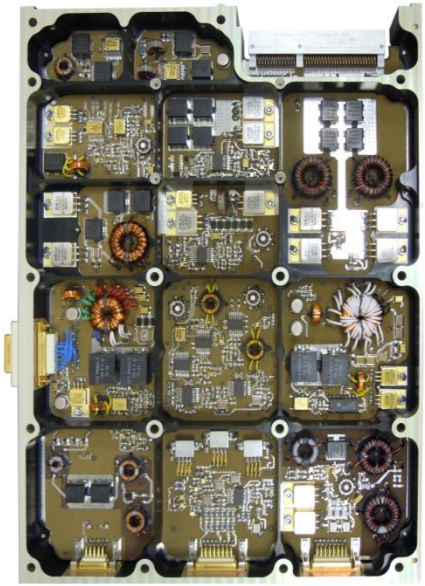
EarthCARE

Customer: Syderal, ESA

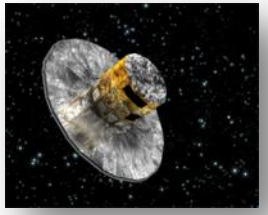
Function: Mass Memory and Formatting Unit (MMFU) Power Supply Boards (PSB) for the EarthCARE ESA Mission

Features:

- 5 output rails (+5V, +3.4V, +1.8V, -12.25V and +1.5V) for the Controller and Mass Memory Boards.
- Input in-rush current control
- Common mode and differential input noise filters
- Input under-voltage protection
- Input reverse polarity protection
- Over-load and output short-circuit protection
- Output filters
- Magnetic feedback
- Open Loop Gain Specs: PM> 60°; GM > 10dB



PDHU PSB



GAIA

Customer: Syderal, ESA

Function: Payload Data Handling Unit (PDHU) Power Supply Boards (PSB) for the GAIA ESA Mission

Features:

- 5 output rails (+5V, +3.3V, +2.5V, +1.8V and +1.5V) for the Controller Boards.
- 2 output voltages (+12V and +3.3V) for the Mass Memory Boards
- Common mode and differential input noise filters
- Input under-voltage protection
- Input reverse polarity protection
- Over-load and output short-circuit protection
- Output filters
- Magnetic feedback
- Open Loop Gain Specs: PM> 60°; GM > 10dB

LVPS for Avionic Applications

Customer: Prime Italian Defence Industry

Function: Low Voltage Power Supply for Avionic Applications

Features:

- Common mode and differential mode input noise filter
- Input spikes suppression
- Input under- and over- voltage protection
- Output over- and under- current protection
- Output over-voltage protection
- Fail and overheat status outputs
- Battle Short input
- Internal Thermal switch
- Integrated total elapsed-time recorder (ETR)

Thank you for your attention!

phone: +39 080 53 21 796
Fax: +39 080 53 55 048
e-mail: info.space@sitael.com

SITAEL S.p.A.
S. P. 231, KM. 79.900 - 70026 Modugno (BA)
Via Livornese 1019 - 56122 Pisa (PI)
ITALY
www.sitael.com