TAS Astro
Satellite Electrical Systems
BE

AIRBUS
DEFENCE & SPACE

Exercice : Telecom satellite

- Instructions:
  - You shall work on groups of 2.
  - You can use the Presentations from the lessons.
  - You shall send to Corinne a Technical Report (PDF – 10 pages maximum) by **February 8th at 17:00 (CET)**.
  - Each exercice (except 3) is independent from one another:
    1. Solar array sizing
    2. Battery sizing
    3. Solar array (battery charge sections)

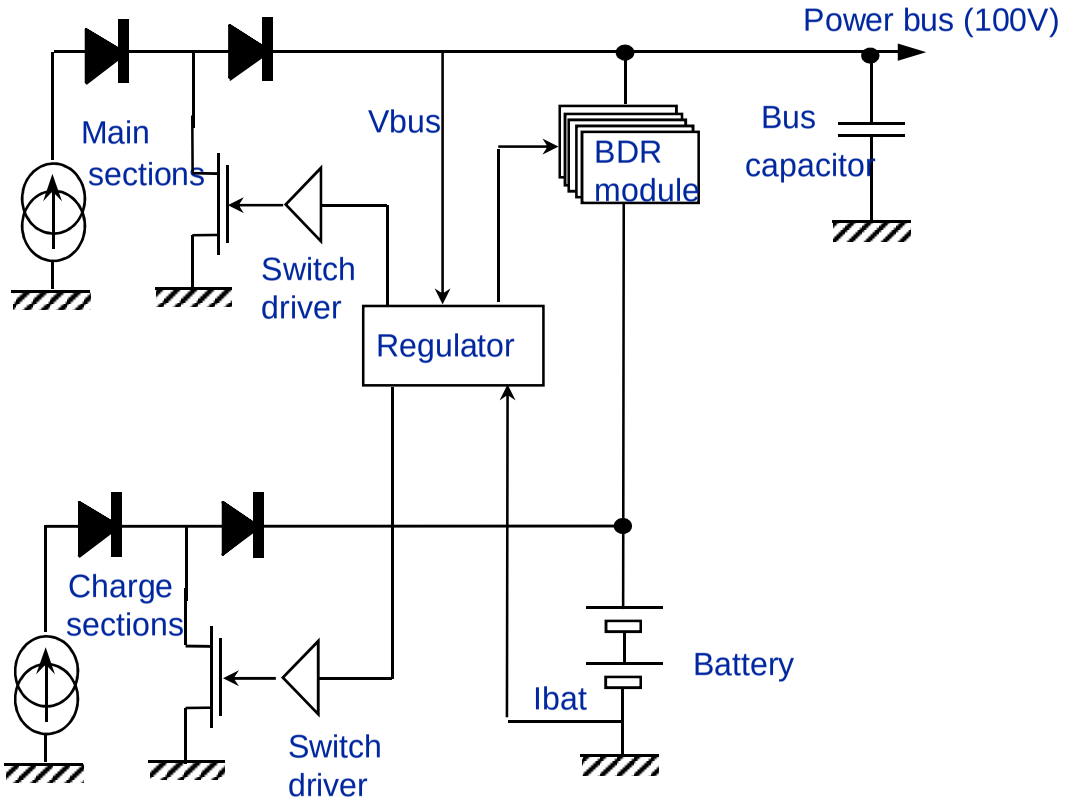
AIRBUS DEFENCE & SPACE

Exercice : Telecom satellite

- Requirements
  - Geostationary orbit
  - 15 years lifetime
  - 100V regulated bus
  - 12kW payload consumption + 3 kW platform consumption
  - Margin on battery: maximal DOD = 80%, including possible failures
  - Margin on solar array: 7% on power required by customer

Exercice : Telecom satellite

- Power architecture
  - E3000 architecture – 100V regulated bus

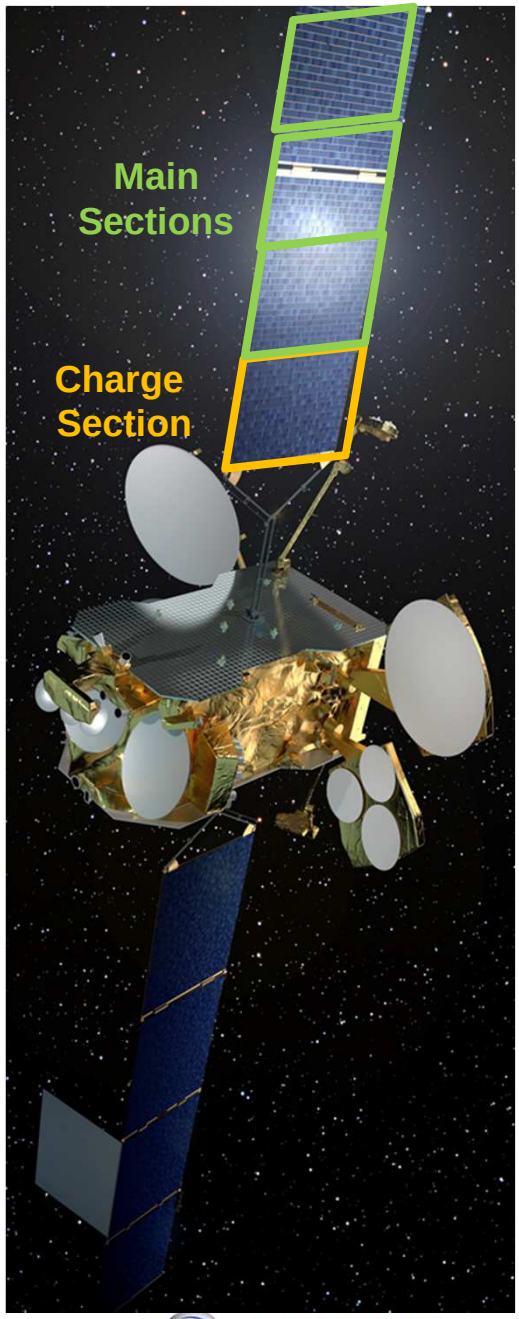


AIRBUS DEFENCE & SPACE

Exercice : Telecom satellite

- Power architecture

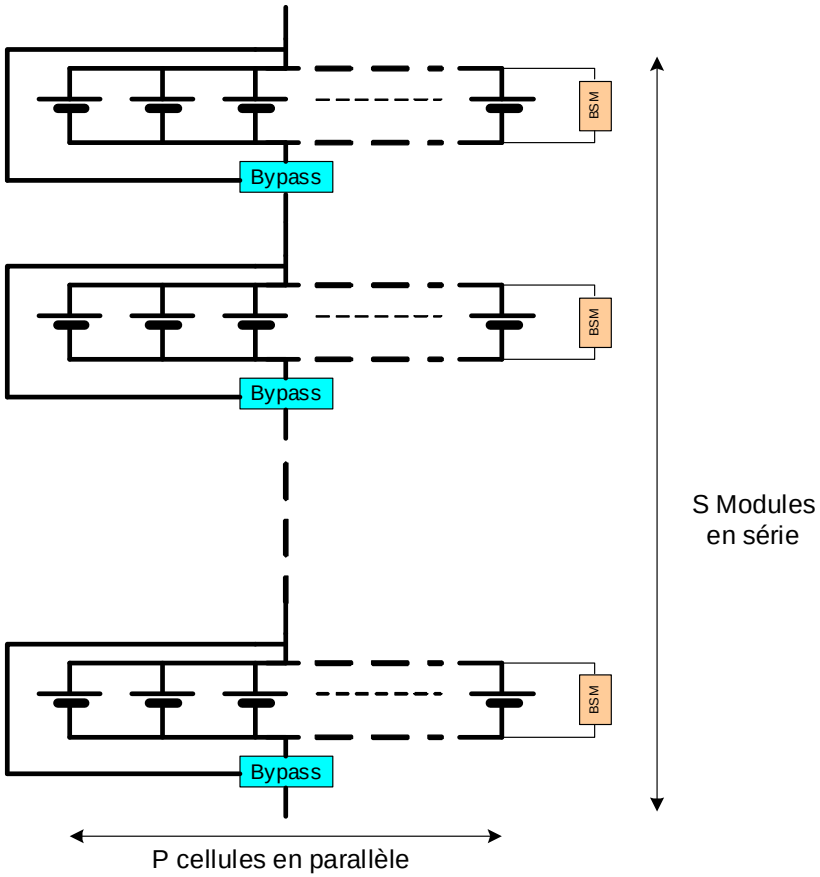
• Solar Cell:	Azurspace 3G30C
• Solar Flux:	see Figure at the end
• Loss factor	0.9707
• Total SA line Vdrop	2.5V
• Max mission duration	15 years
• Radiation dose:	1E+15 MeV
• Temperature range	
• Hot Case:	50°C
• Cold Case:	40°C
• Fill factor	80%



AIRBUS
DEFENCE & SPACE

Exercice : Telecom satellite

- Power architecture
  - Battery : SAFT VES 140 (Simplified datasheet given in the annex)



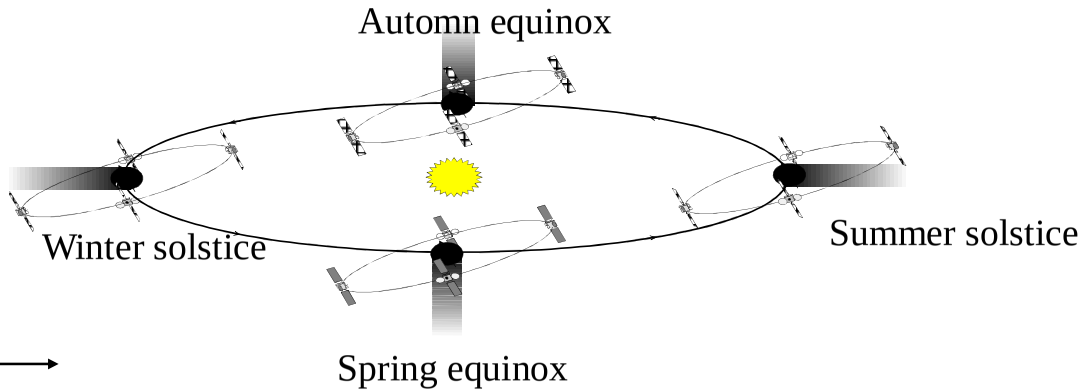
BDR :

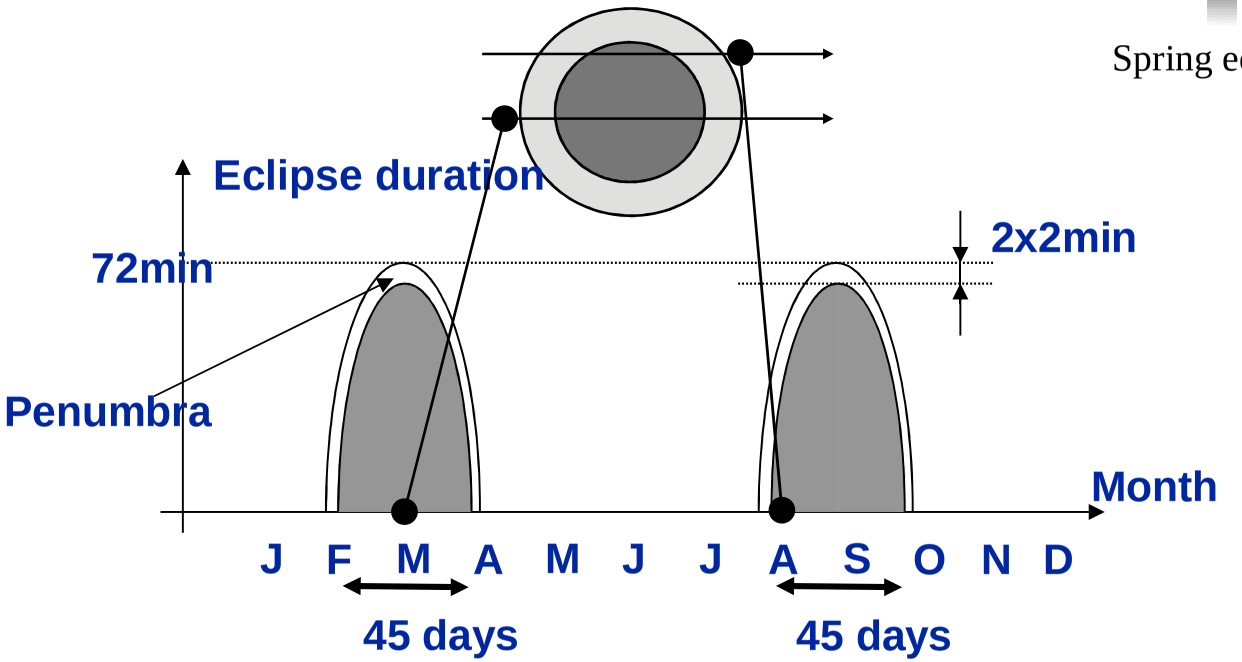
Max input Voltage :	100V
Min input Voltage :	60V
Efficiency :	95%

AIRBUS DEFENCE & SPACE

Exercice : Telecom satellite

- Orbital data
  - Altitude 36000 km
  - Geostationary orbit





AIRBUS DEFENCE & SPACE

Exercice : Telecom satellite

- Power architecture assessment

1. Solar array sizing
   - Hot case
   - Cold case

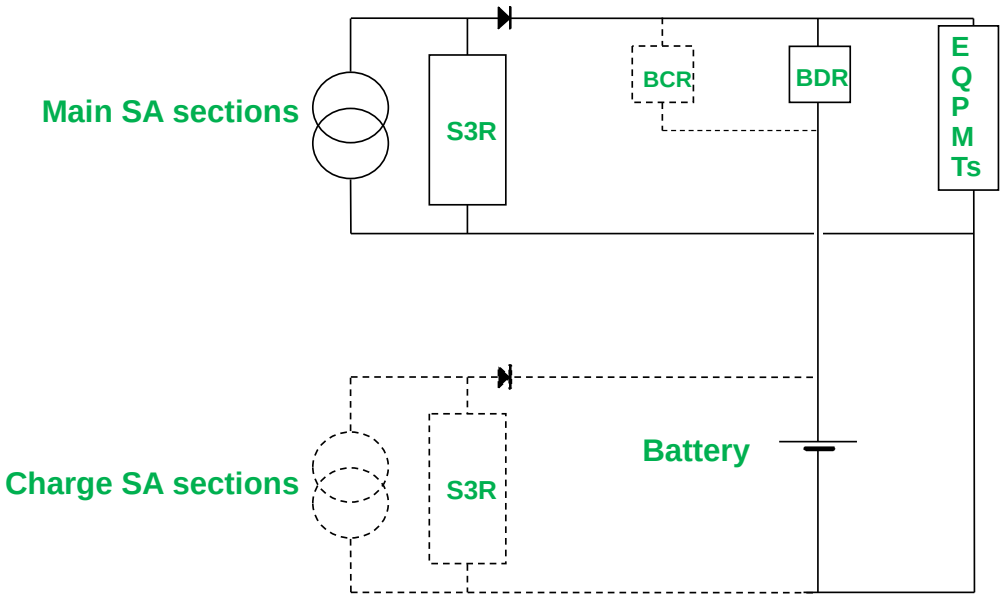
2. Battery sizing

3. Solar array (battery charge sections)
   Sizing thanks to battery charge constraints

AIRBUS DEFENCE & SPACE

Exercice : Telecom satellite

- Sizing of Solar array dedicated to battery recharge
  - Start from battery sizing (have a look to the battery discharged need !)
  - Overview of the situation



  - Think about the GEO orbit where the eclipse is longer, to define the recharge constraints
  - Consider the efficiency of the recharge equal to 90%

AIRBUS DEFENCE & SPACE

Exercice : Telecom satellite

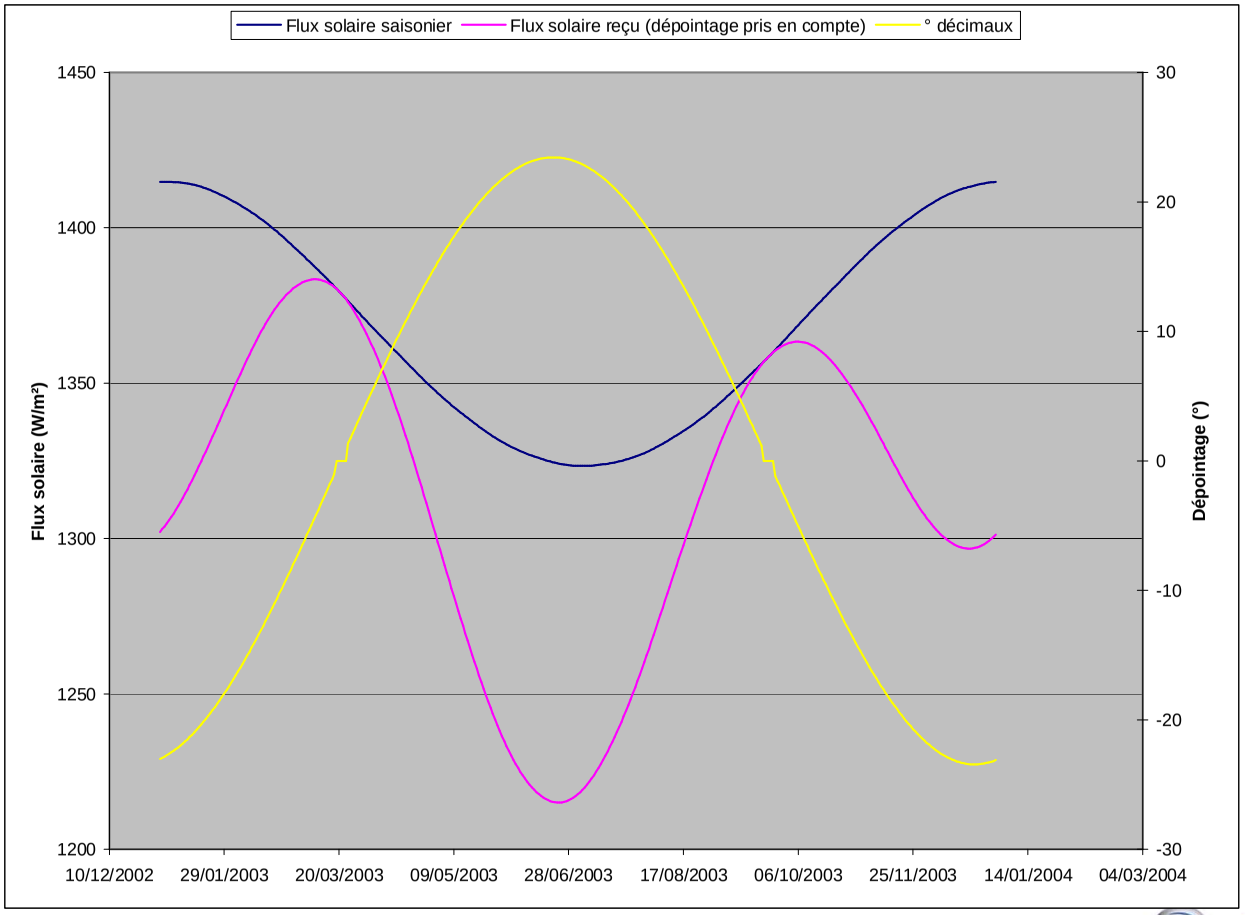
- Battery sizing
  - Determine the min an max cell number in series
  - Max energy to be powered by the battery ?
    - Battery sized for what duration ?
  - What about the battery capacity ? Number of cell in parallel ?
  - What about the failure mode ?

Questions ?

AIRBUS
DEFENCE & SPACE

Annex

Geostionary flux



AIRBUS DEFENCE & SPACE

Annex

Battery parameters (Simplified from datasheet)	
Nominal Capacity	40 Ah
Maximum Voltage	4.1V
Minimum Voltage	3 V
Average voltage	3.5V
Bypass resistance	100 µΩ

SAFT VES140 Datasheet

Cell electrical characteristics	
Nominal voltage	3.6 V
Nominal capacity at C/1.5 rate at 4.1 V/3 V & 20°C	39 Ah
Maximum discharge current at 25°C	100 A (Continuous ~2 s pulse)
Specific energy (minimum)	126 Wh/Kg
Energy density	140 Wh/l
Cell mechanical characteristics	
Diameter	53 mm
Height	250 mm
Mass	1.13 kg
Mechanical environment Leak rate	Qualified all launchers 10^{-8} dm³ atm s^{-1}
Cell operating conditions	
Lower voltage limit for discharge	Continuous (0°C to + 45°C) 2.7 V
Charging method	Constant current/constant voltage (CCCV)
Charging voltage (max)	4.1 V
Recommended continuous charge current	GEO/MEO C/10 LEO (20 % DOD) C/5
Operating temperature	Charge + 10°C to + 35°C Discharge 0°C to + 40°C
Storage and transportation temperature	- 40°C to + 65°C

AIRBUS
DEFENCE & SPACE