



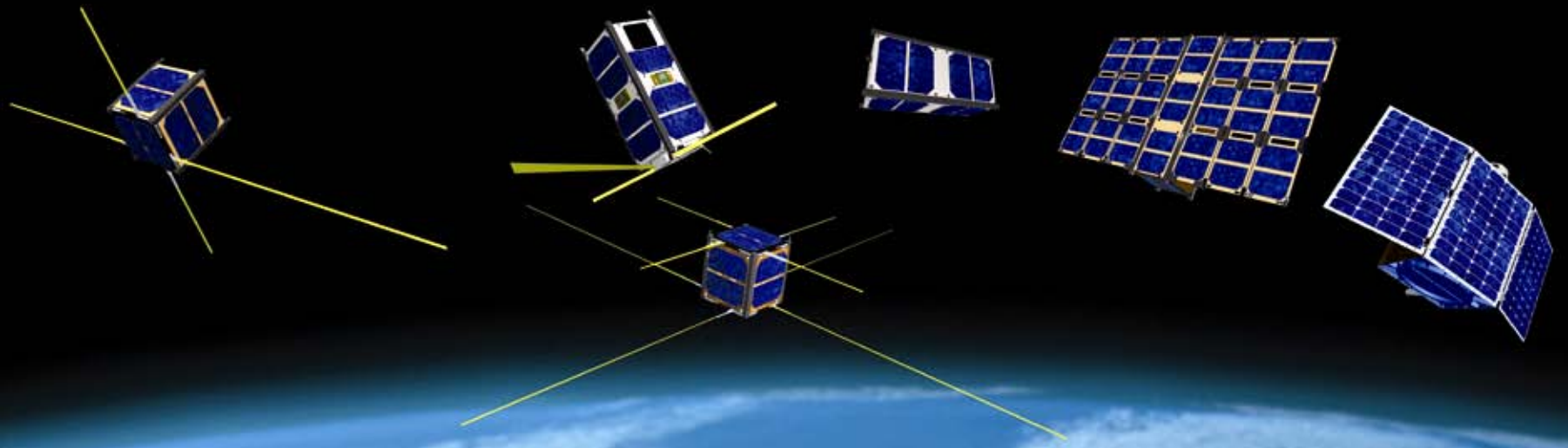
ISIS – Innovative Solutions In Space

Next generation Power Systems

High Power Systems for Next Generation Big Nanosatellites

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Where are we now?

- Most flying Cubesats are currently 1U (1kg)
- Increasing number of 2U-3U in orbit (2 – 3 kg)
- 6U, 12U are mainly under development (6 – 20 kg)
- Bigger satellites have completely different power systems (30 – 60 kg)





Where are we now?



- Most flying Cubesats are currently 1U (1kg)
 - 10 W power class EPS
- Increasing number of 2U-3U in orbit (2 – 3 kg)
- 6U, 12U are mainly under development (6 – 20 kg)
- Bigger satellites have completely different power systems (30 – 60 kg)





Where are we now?



- Most flying CubeSats are currently 1U (1kg)
- Increasing number of 2U-3U in orbit (2 – 3 kg)
 - 20W – 30W power class EPS
 - Deployable becoming common
- 6U, 12U are mainly under development (6 – 20 kg)
- Bigger satellites have completely different power systems (30 – 60 kg)



Where are we now?



- Most flying Cubesats are currently 1U (1kg)
- Increasing number of 2U-3U in orbit (2 – 3 kg)
- 6U, 12U are mainly under development (6 – 20 kg)
 - Complex Deployable panels
 - 40W – 80 W peak power needed
- Bigger satellites have completely different power systems (30 – 60 kg)



Where are we now?



- Most flying Cubesats are currently 1U (1kg)
- Increasing number of 2U-3U in orbit (2 – 3 kg)
- 6U, 12U are mainly under development (6 – 20 kg)
- Bigger satellites have completely different power systems (30 – 60 kg)
 - 80 – 100 W power class EPS



Where will we be in 3 years?

- 1U Cubesats used for simpler/compact missions
- 2U and 3U the new standard for CubeSat Science missions
- 6U, 12U and up will become key





Where will we be in 3 years?

- 1U Cubesats used for simpler/compact missions
 - First hands on experience
 - Small technological demonstrators
 - Highly miniaturized payloads
- 2U and 3U the new standard for CubeSat Science missions
- 6U, 12U and up will become key



Where will we be in 3 years?

- 1U Cubesats used for simpler missions
- 2U and 3U the new standard for CubeSat Science missions
 - Small size payloads
 - Commercial applications possible
- 6U, 12U and up will become key



Where will we be in 3 years?

- 1U Cubesats used for simpler missions
- 2U and 3U the new standard for CubeSat Science missions
- 6U, 12U and up will become key
 - High-end miniaturized scientific instruments
 - Many commercial / defense applications
 - Bridging the gap with small micro satellites
 - Cubesats going up in weight / size, microSats going down!

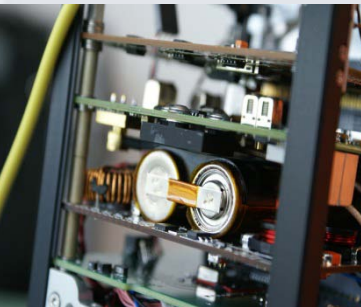


Perceived bottlenecks

- Available power
 - Breaking the 30W barrier
- Redundancy
 - One string is not always enough
- Scalability
 - Modularity



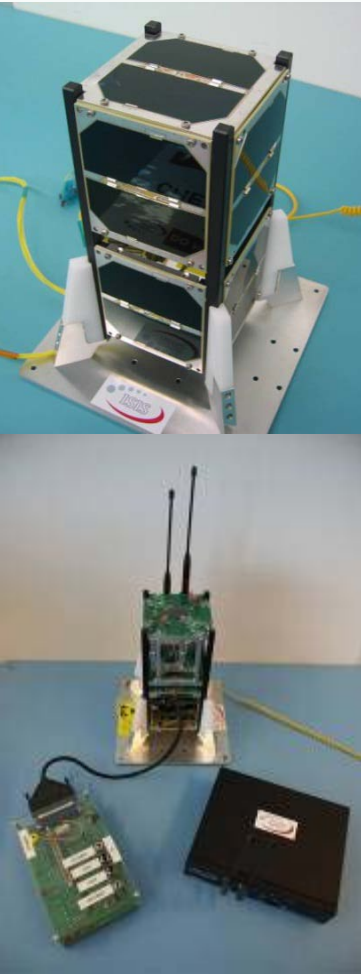
Breaking the 30W barrier



- Satisfy needs of high-end payloads
 - 30W peak power are not enough
 - Target: 60W
- Support a higher number of solar cells strings
 - Deployable panels are becoming common
- How to transfer 60W to the payload?
 - CSKB connector not suited
 - Useless to route high power to the whole satellite
 - Dedicated power bus to the payload
 - Customizable high voltage bus (up to ~28V)



One string is not always enough



- Most of the Cubesats are single string designed
 - Simple system
 - Low cost
 - Risk has to be tolerated
- Risk is not always tolerable
 - Need of High-reliability EPS
 - Power is one of the most critical systems
- Why not using 2 power systems?
 - Divide the risk
 - Graceful performance degradation

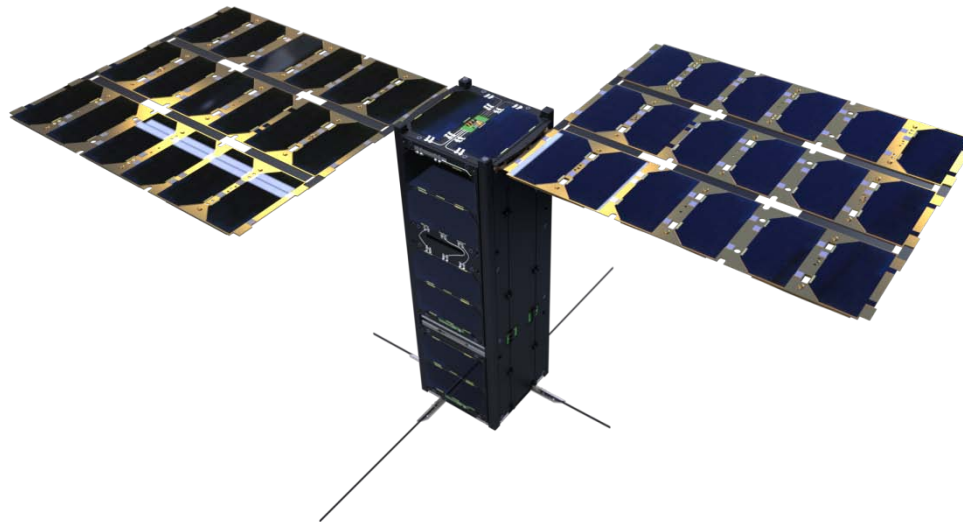


Modularity

- One solution to fit a wide range of missions
 - Reuse the Core design
 - Scalability is critical
- Scalability on power generation
 - Modular MPPT units to accommodate multiple deployables
 - Modular BCR to accommodate different needs
- Scale the number of power buses available
 - Advanced power control on-board



- ISIS and Systematic Design are cooperating in the development of a Power System
- Develop an EPS targeted for
 - High-end nanosatellites
 - Satisfy needs from 2U to 24U
 - Focus on a scalable and robust design





Introduction to the ISIS iEPS



- High output power
 - Up to 60W in a single subsystem
 - Targeted for multiple deployable panels
 - Scalable energy storage
- Next generation EPS
 - Fully redundant solution possible
 - Graceful performance degradation





Introduction to the ISIS iEPS



- 4 MPPT controllers (4 – 8 TJ solar cells)
 - Stackable MPPT controllers for supporting deployable / body mounted cells
- Stackable battery boards
- Multiple power busses available
 - Standard 3V3, 5V
 - High voltage bus (up to ~ 28V)
 - Customizable output voltages
 - Redundant power switch units





Unique features

- EPS features
 - Backdoor access:
Achieve EPS control even with main bus stuck
- Ground support equipment
 - Fast development & test of single systems
 - Use the board without an OBC
- “Conventional Space Industry” PA/QA
 - Elaborate documentation
 - Professional customer support
 - Extensive Test reports

