



NETS

2026

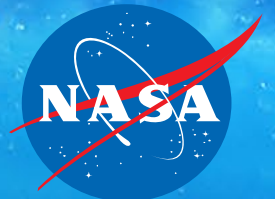
Controllers for Stirling Conversion

Sal Oriti, *Stirling Generator Technical Lead*

Max Yang, Chris Barth

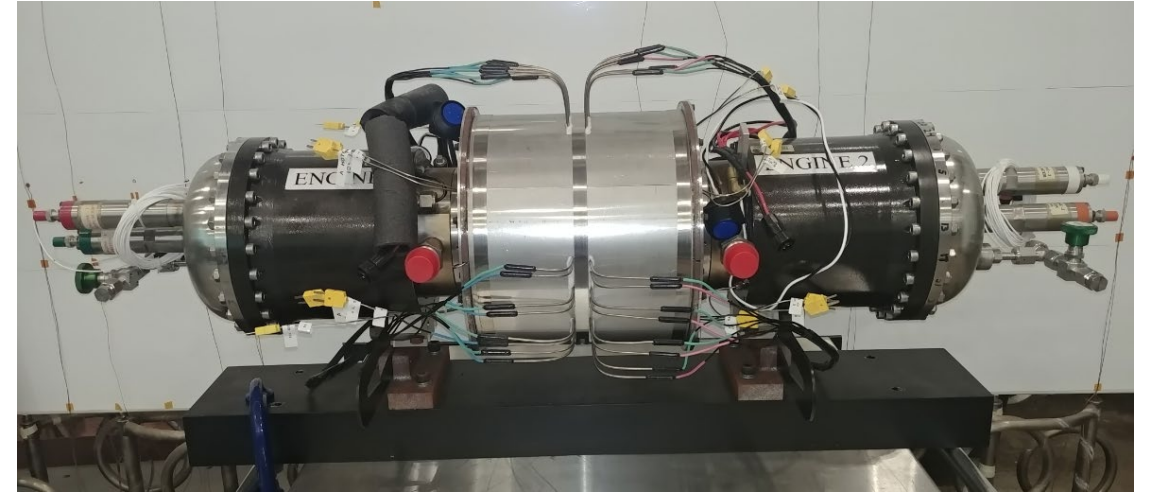
Thermal Energy Conversion Branch

NASA Glenn Research Center



Why is a controller needed?

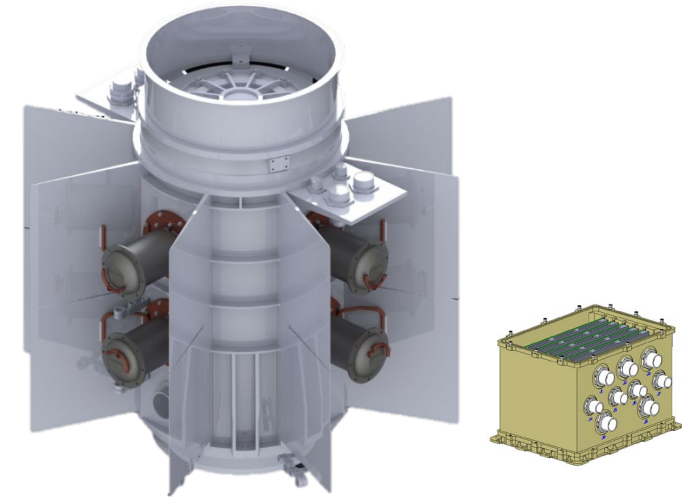
- Power conditioning (i.e. 28V for RPS)
- Control piston amplitude via proper electrical load
- Power factor correction
- Spacecraft bus fault handling
- Power conversion telemetry



kW-class power (Fission source)

What are the requirements?

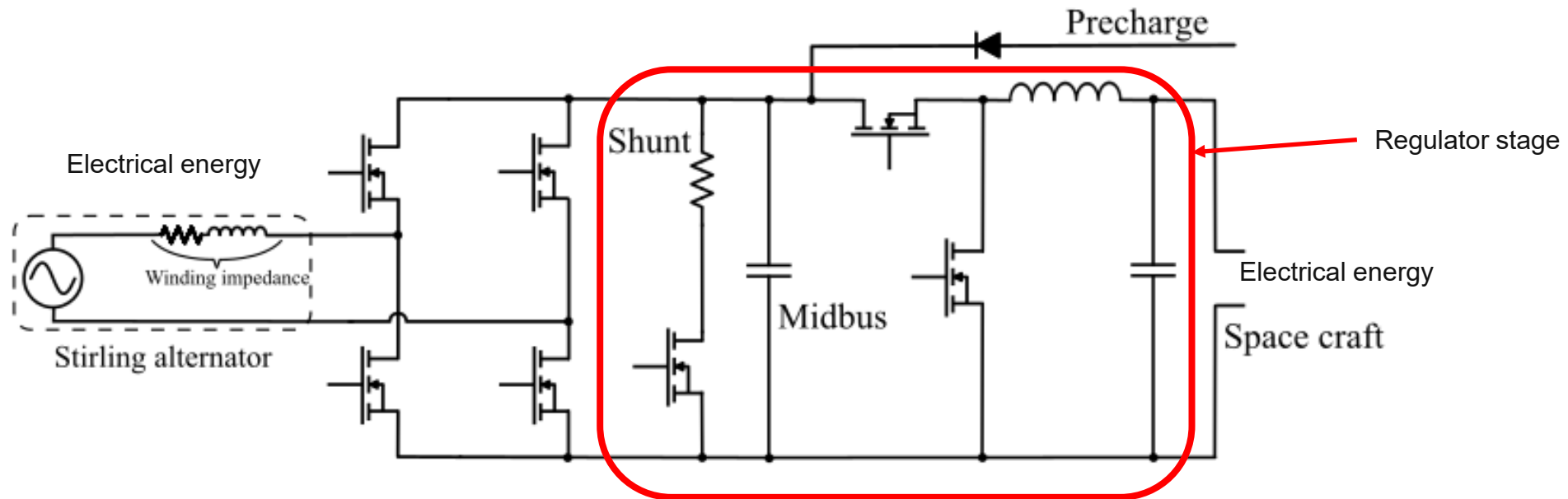
- Deep space, Lunar, planetary
- GCR, Jovian radiation belts, reactor proximity
- High efficiency (>85% for low power, >94% for kW-class)
- Long-term continuous operation (i.e. 17 yrs for outer planets)
- Internal fault tolerance (i.e. redundancy)
- Simple spacecraft con-ops (behaves like RTG to user)



Stirling RPS (100s of watts)

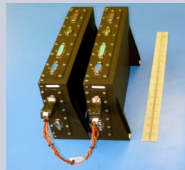
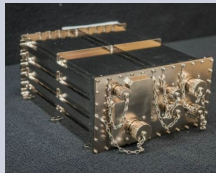
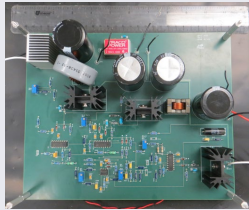
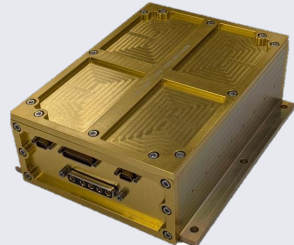
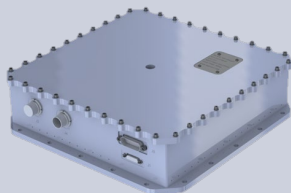
How does a Stirling convertor controller work?

- Active algorithm-controlled H-bridge negates alternator inductance
- Piston amplitude controlled via reference voltage setpoint
- Regulator stage to provide 28V regulated power and handle bus faults
- Shunt (external) to dissipate power in absence of spacecraft

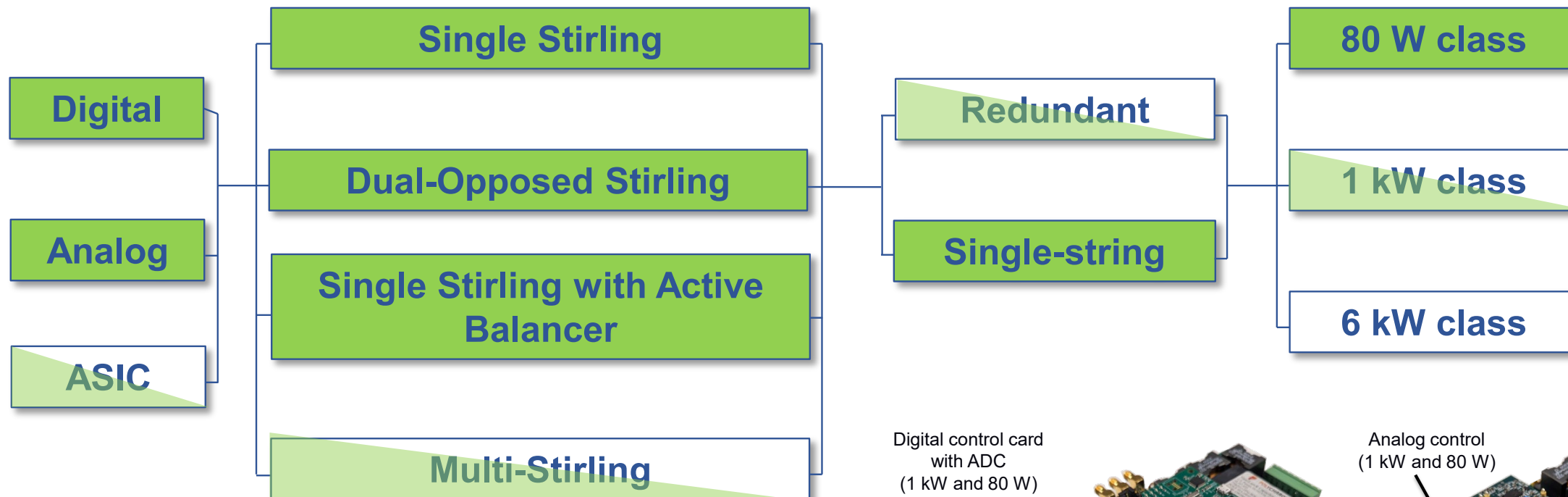


Active power factor correction controller schematic

Current Status

			Name	Org	Status	Hardware Level
Legacy			SCC (single), DCC (dual) HVCC (high-voltage) ACU	JHU APL Lockheed Martin	Demonstrated Stand-by	Engineering Units
Analog			NAC (NASA analog controller)	NASA GRC	Demonstrated, Needs development	Breadboards
			Capless NAC	NASA GRC		
Digital			NASA Digital controller	NASA GRC	Demonstrated Convertor + balancer Dual convertor Active development	Engineering Units
			SCSC (single convertor)	West Coast Solutions (Phase II SBIRs)	Demonstrated Convertor + balancer Active development Multi-convertor in dev	Engineering Unit

GRC Internal Controller Dev Status



Digital control card
with ADC
(1 kW and 80 W)

Analog control
(1 kW and 80 W)

Power card
(Dual 80 W channels for dual
Stirling or Stirling+balancer)