



Design of Electric Aircraft e-Spirit of St. Louis

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Inspiration





Overview



- Clean, quiet flight
- Fully electric aircraft designed by students
- 2 hours cruising endurance
- Max continuous power 75 kW (100 HP)
- Ground charging (9 hours)
- Work with the FAA and ASTM on the certification requirements for electric aircraft.



Design Team



Dr. Pat Anderson
Advisor

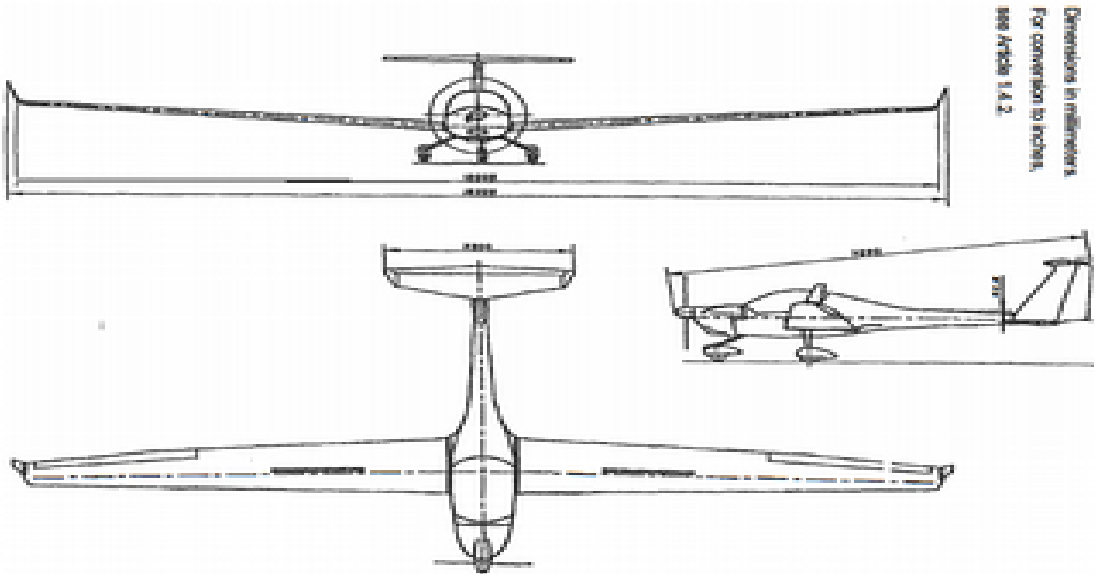


Erik Lindbergh
Ambassador





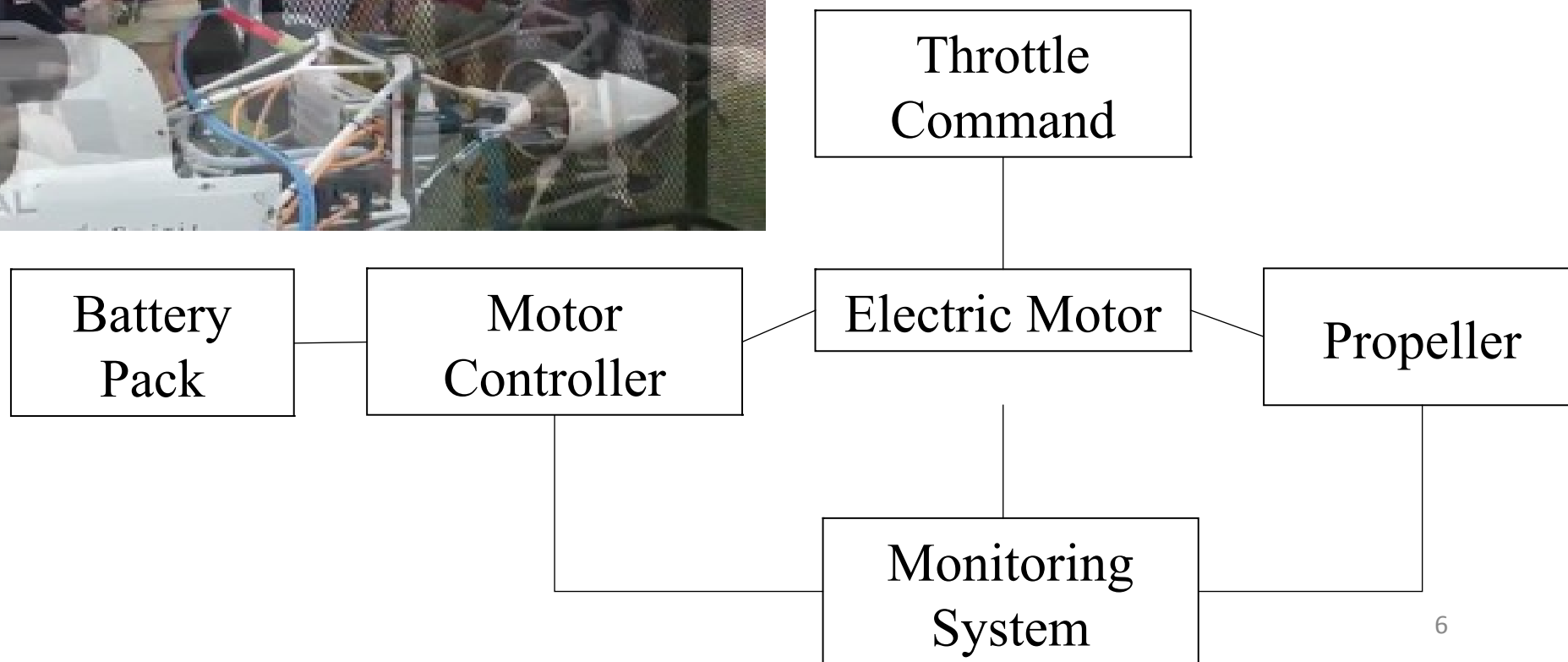
HK-36 TTC Super Dimona



Parameters	Values
Wing Span	16.3 m (53.6 ft)
Length	7.3 m (23.9 ft)
Glide Ratio	1:27
Stall Speed	78 km/h (42 kts)
Cruise Speed	109 km/h (59 kts)
MTOW	770 kg (1698 lbs)
Empty Weight	567 kg (1250 lbs)



Electric System





Electric Motor



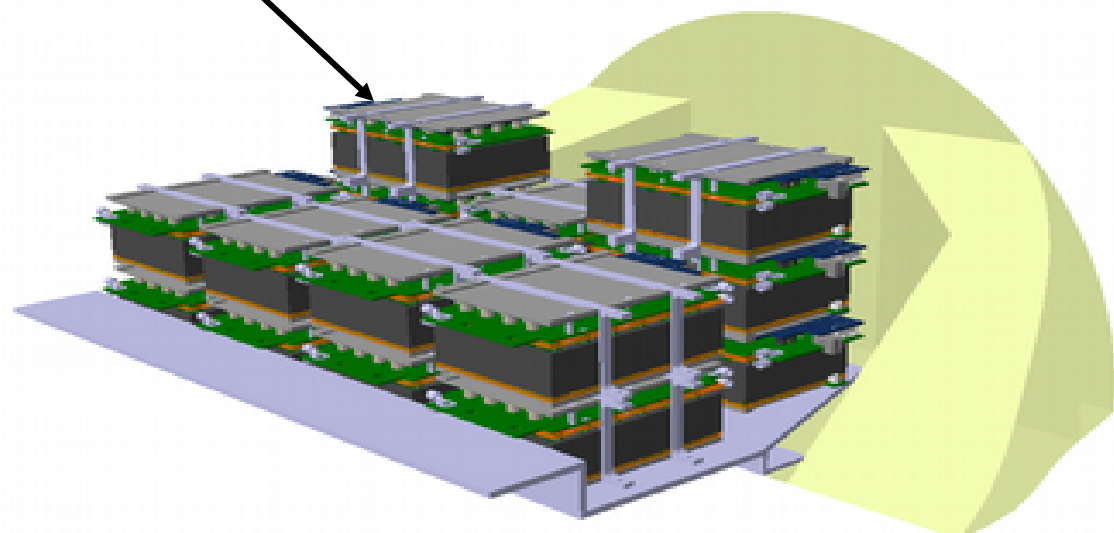
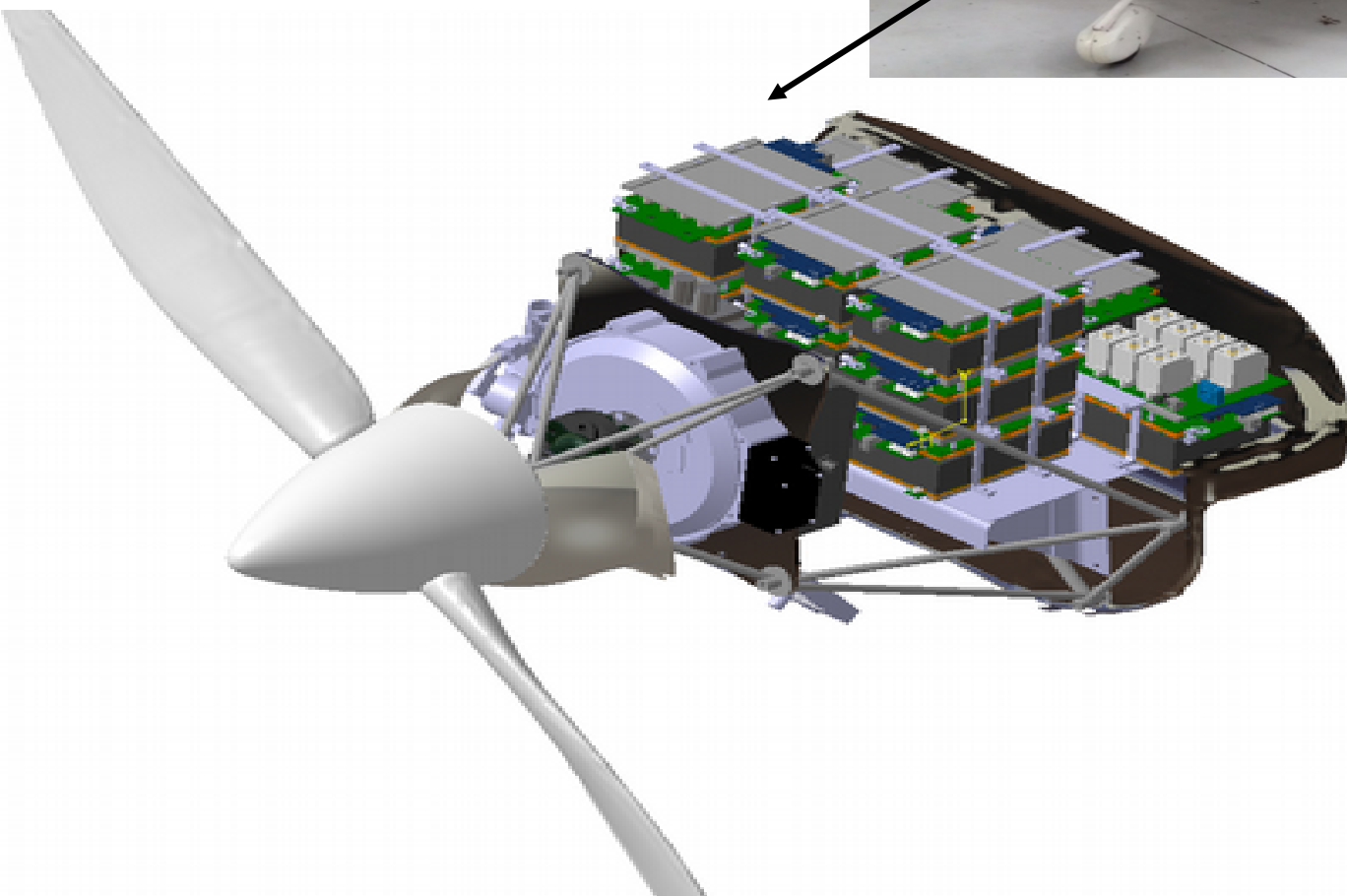
- YASA-750 (75kW / 100HP)
 - Axial flux electric motor
 - AC, 3-phase, oil cooled, permanent magnet motor



Specifications	Values
Weight	33 kg
Peak Power	200 kW @ ~700 V
Peak Torque	>790 Nm @ 450 A
Continuous Power	>75 kW
Peak Efficiency	>95 %
Max Speed	3250 RPM
Size	350 mm dia x 66 mm

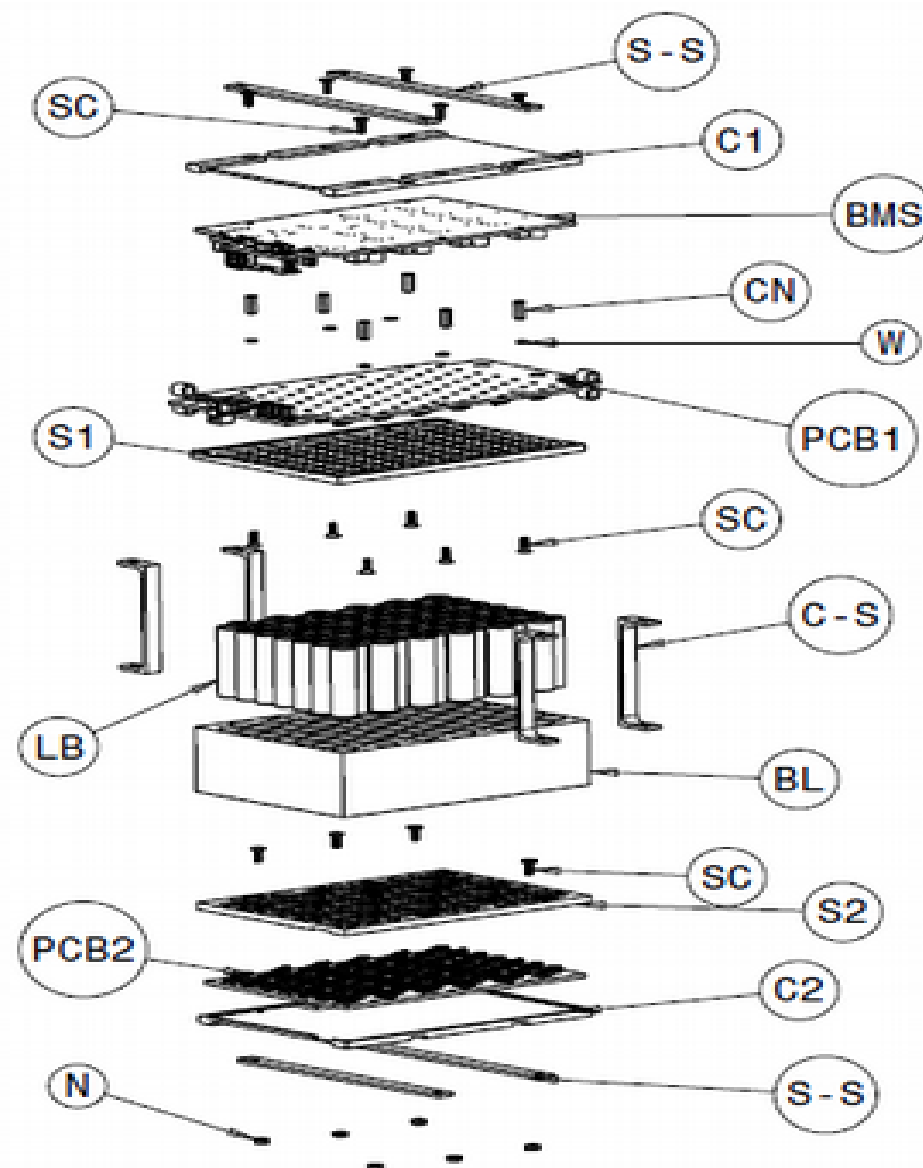
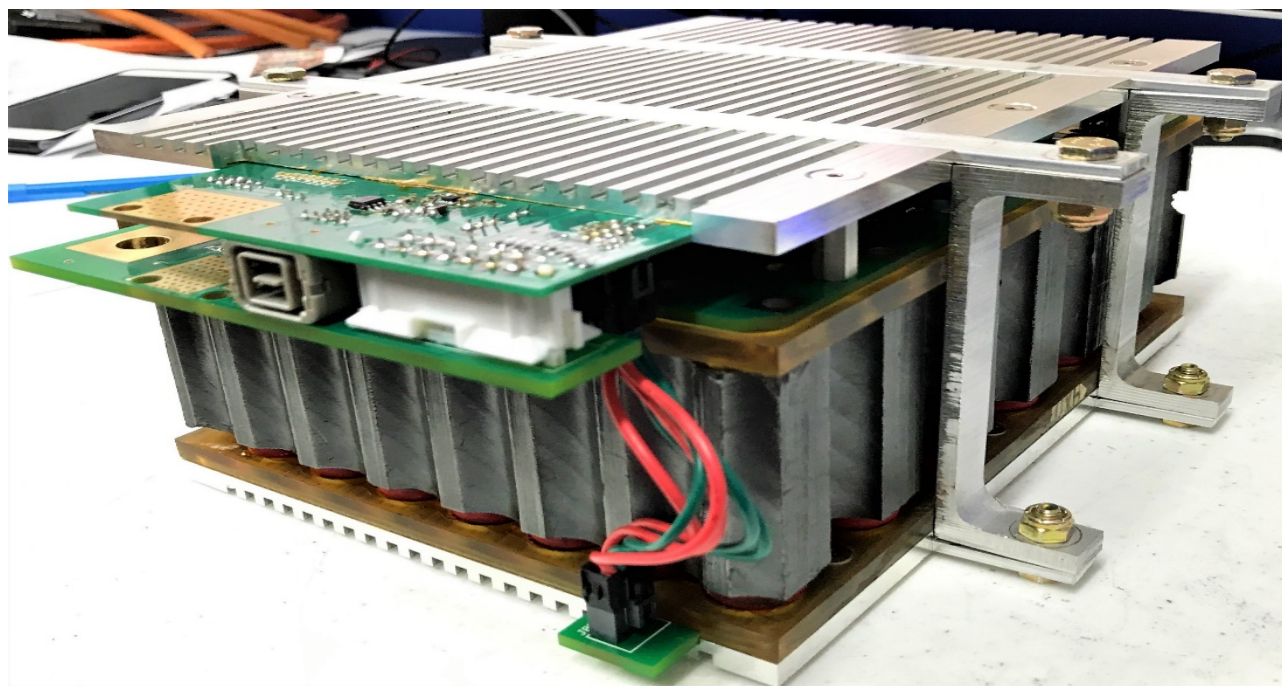


Battery Pack Design

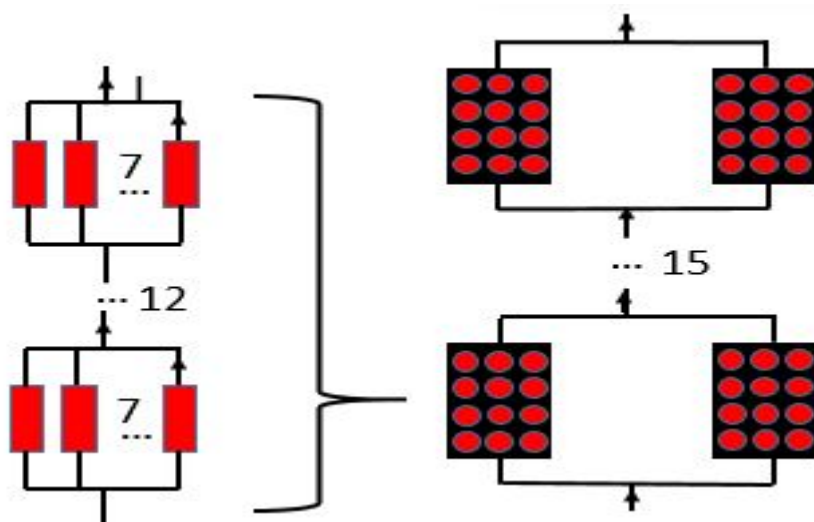




Battery Pack Design



- Panasonic NCR18650GA Li-ion Batteries
- Capacity: 31 kW-hr (42 HP-hr)
- 2520 cells (7P12S x 30)
- Max deliverable: 756 V x 140 A



Specifications	Values
Weight	48 g
Rated Capacity	3300 mAh
Specific Energy	224 Wh/kg
Max Current	10 A
Nominal Voltage	3.6 V
Size	18 mm dia x 65 mm



Battery Cooling

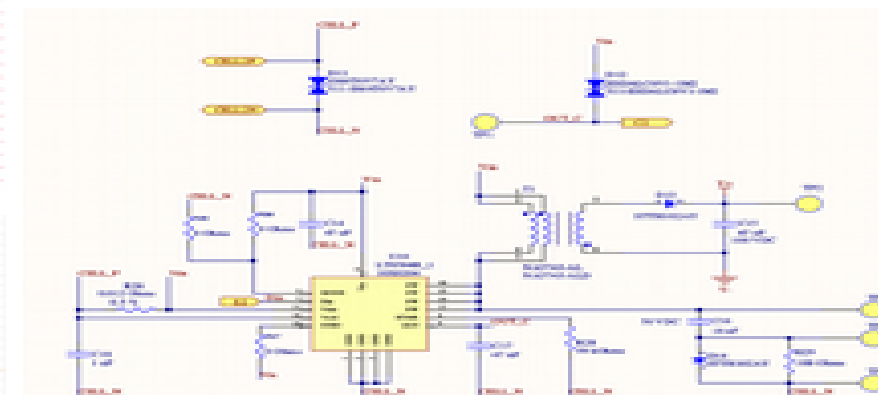
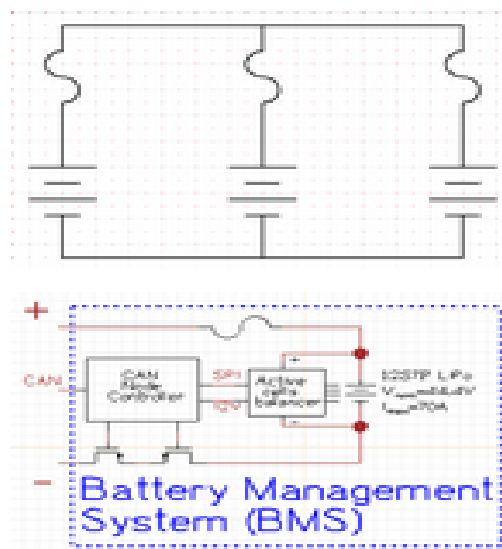
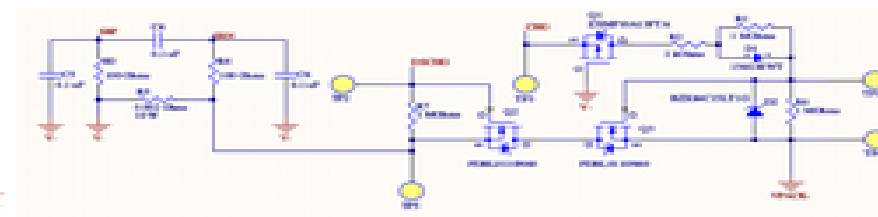
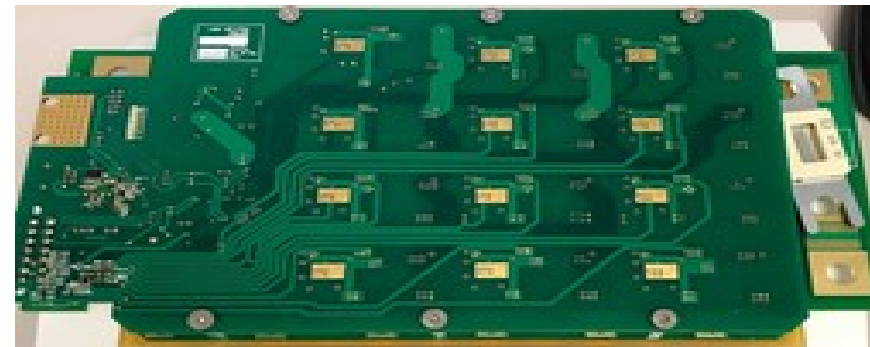


- Phase Changing Graphite (PCC)



Specifications	Values
Melting Point	55°C
Melting Range	48°C - 57°C
Density	875 kg/m ³
Specific Heat	1.96 J/g°C (Solid) 2.20 J/g°C (Liquid)
Latent Heat	165 J/g

- Protection functions
 - Over-voltage
 - Under-voltage
 - Over-current
 - Temperature
- BMS monitors every 7 batteries
- Cell level fuse
- Active balancing
- CAN interface





Battery System Weight Fraction



Sub-system	Weight Fraction in relation to W_0	Weight Fraction in relation to W_{Bat}
Battery Cells	15.7%	58.0 %
Housing Structure	1.6%	6.0 %
Cooling System	3.7%	13.7 %
BMS	3.5%	13.0 %
Wiring	2.5%	9.4 %
Total	27.1 %	100 %



Challenges



Require customized hardware

- Electric Motor
- Motor Controller
- Battery Management System
- Pilot interface system

Specific Energy

- Jet fuel vs. Li-ion batteries



1 L



900 cells

Certification

- Limited resources on electrical aircraft certification standards



Interested?



Thank you!

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