

High Altitude Balloon

Power Bus Development Team

- Todd Rogers
- Aoun Barki
- Henok Feseha

February 2009

Faculty Advisors

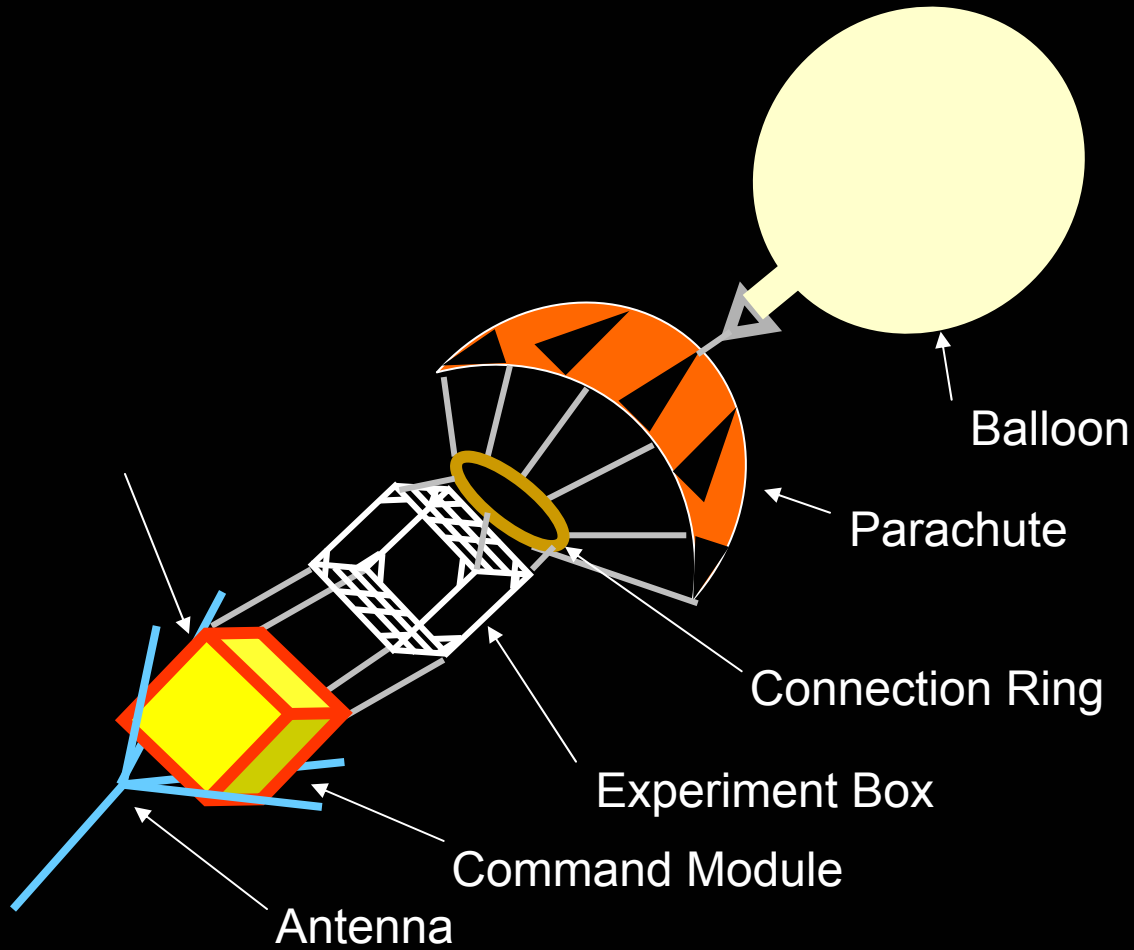


- John Wu
- John Gallagher
- Joseph Slater
- Bruce Rahn (Mentor)

Introduction to HIBAL Design

- What is HIBAL?
 - Dedicated to the exploration of near space for scientific and educational purposes
 - Undergraduate and Graduate Students
 - Multidisciplinary projects

Balloon Setup



Objective

- Design a universal power bus that replaces multiple power sources
 - Reduce weight
 - Space (physical access)
 - Providing power for 5 to 8 hours
- Research alternate power source
 - Solar panels
 - Secondary power supply

Specifications for Centralized Power Bus Battery Design



- Light weight (two boxes, 12 lb limit)
- Small size (area inside box is limited)
- Temperature sensitive (0° C at 85 K ft.)
- Rechargeable
- Power all components for 5 hours

Centralized Power Bus Battery Design (8 hrs)

	Input Voltage - Max	Input Current (A) Nominal	Power Consumption (Watts)	Amp Hours
Garmin GPS model number GPS15L	5.4	0.085	2.805 - 4.59	0.85
Garmin GPS 25-lvs	6	0.12	0.432 - .72	1.2
Microtrak 300	9	0.18	1.62	1.18
Basic Stamp Version 2.2	9	0.5	27	5
Servo	12	0.01859	0.26	0.12
Cutter	14	0.085	0.459	0.85
3rd gps	3.3	0.085	2.805-4.59	0.85
			Total Power Required 35 Watts	Total Amp Hours 10.05 Ah

Centralized Power Bus Battery Design (5 hrs)

	Input Voltage - Max	Input Current (A) Nominal	Power Consumption (Watts)	Amp Hours
Garmin GPS model number GPS15L	5.4	0.085	2.805 - 4.59	0.53
Garmin GPS 25-lvs	6	0.12	0.432 - .72	0.75
Microtrak 300	9	0.18	1.62	1.13
Basic Stamp Version 2.2	9	0.5	27	3.13
Servo	12	0.01859	0.26	0.12
Cutter	14	0.085	0.459	0.53
3rd gps	3.3	0.085	2.805-4.59	0.53
			Total Power Required 35 Watts	Total Amp Hours 6.72 Ah

Nickel Cadmium Battery

14.4 V – 4 Ah - 37 W

- Weight (4.1 lbs)
- Size (7.56") x (2.4") x (2.6")
- Contains memory effect
- Higher cost than average
- Temperature range (-40° C to +70° C)
- Stronger, less likely to damage
- Rechargeable



Nickel-Metal Hydride Battery

14.4 V – 10 Ah – 144 W

- Weight (4.6 lbs)
- Size (7.8" x 2.3" x 2.2")
- Contains memory effect
- Higher cost than nickel cadmium
- Temperature range (-5° C to +70° C)
- Stronger, less likely to damage
- Rechargeable



Lithium-Ion Battery

14.8V – 7 Ah -95 W



- Light weight (1.1 lbs)
- Rechargeable
- Small size (7.0" L x 2.2" W x 1.2" H)
- Low internal impedance
- Temperature range (-40° C to +80° C)
- If battery completely discharges, it's ruined
- No memory effect (charge at any time)
- Higher cost than nickel-cadmium

Problem: Voltage Conversion

- Power requirements
 - Voltage
 - Current
- Power Bus needs to power all systems

Our solution

- Voltage Regulators
- DC to DC voltage converters
 - Micro-converters
 - Step-up voltage converter
 - Step-down voltage converters
- Several Batteries connected in series

DC Converter

- A DC to DC converter is a circuit which converts a source of direct Current from one voltage to another.
 - Class of Power Converter
- Step-up: Outputs a voltage higher than input
- Step-down: Outputs a voltage lower than input

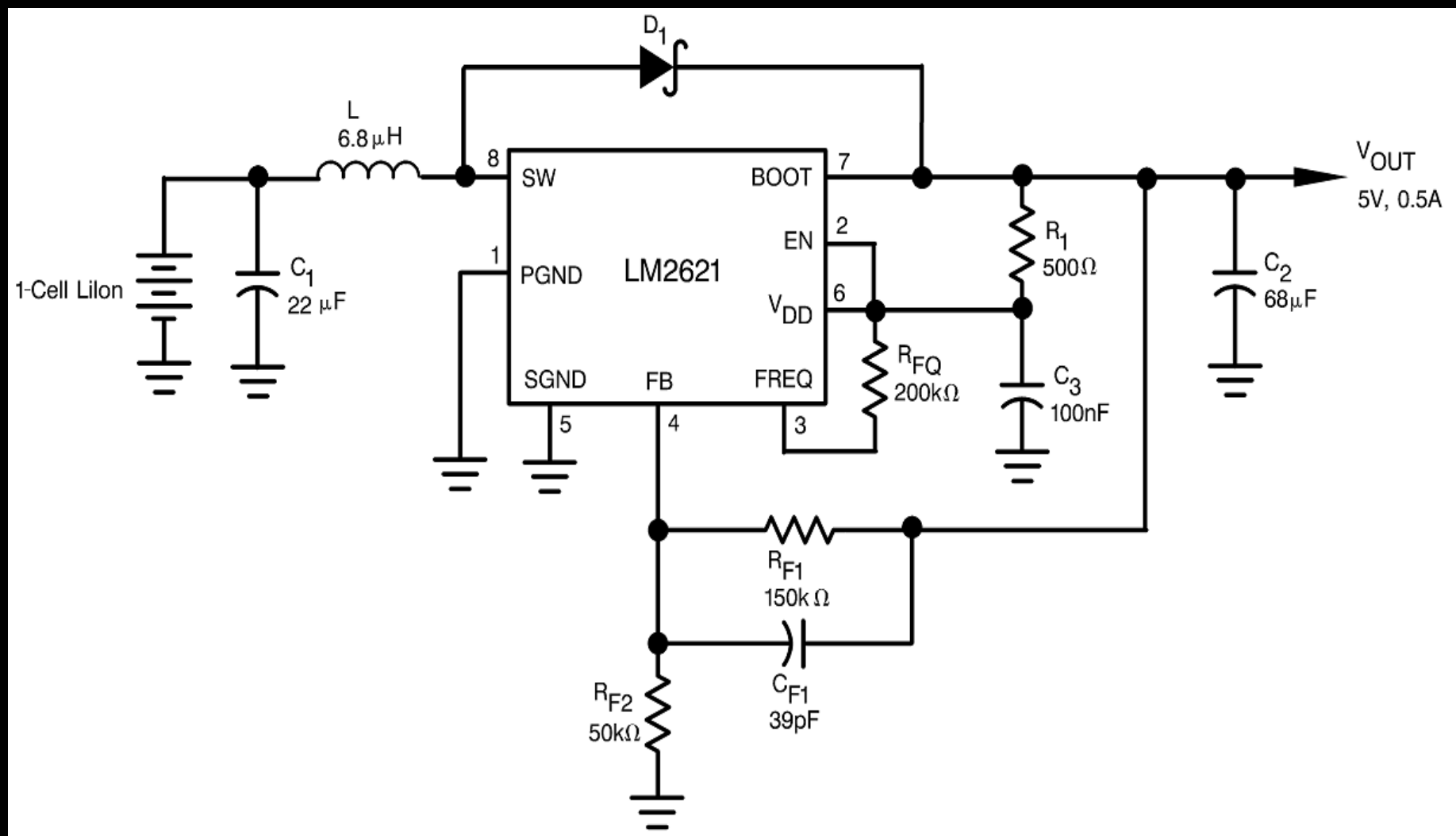
Model Information

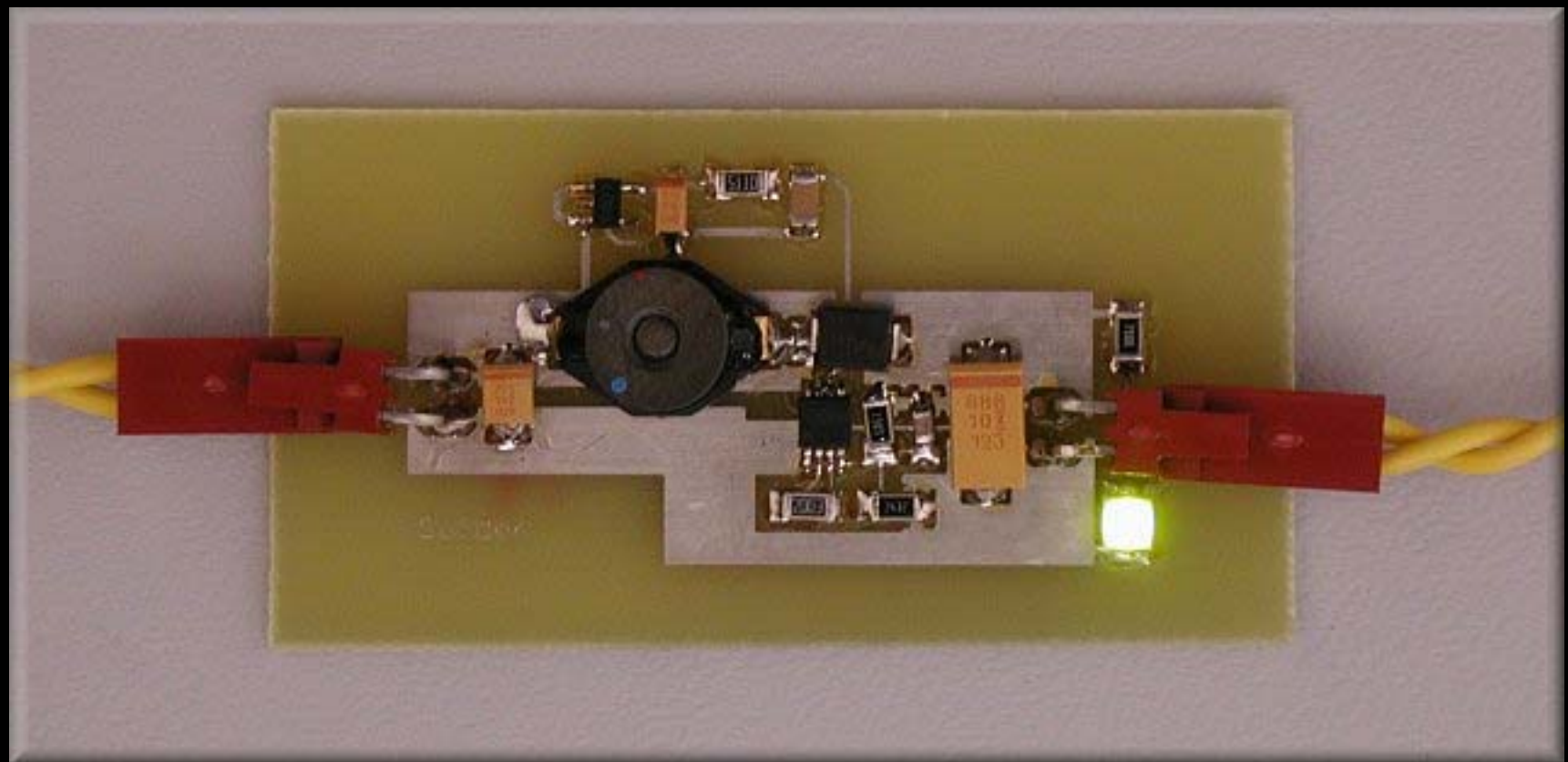
- If input to output isolation is needed, model D112E
 - Has unregulated output
- With Unregulated units the output voltage will vary with change in output load and/or input voltage
- For input to output isolation and regulated output, model SR7805-05W

DC-DC converters

- LM2621 – Low input voltage
 - Step up DC-DC
 - 1.09 mm Package Height
 - 1.2V to 14V Input Voltage
 - 1.24V - 14V Adjustable Output Voltage
 - Up to 90% Regulator Efficiency

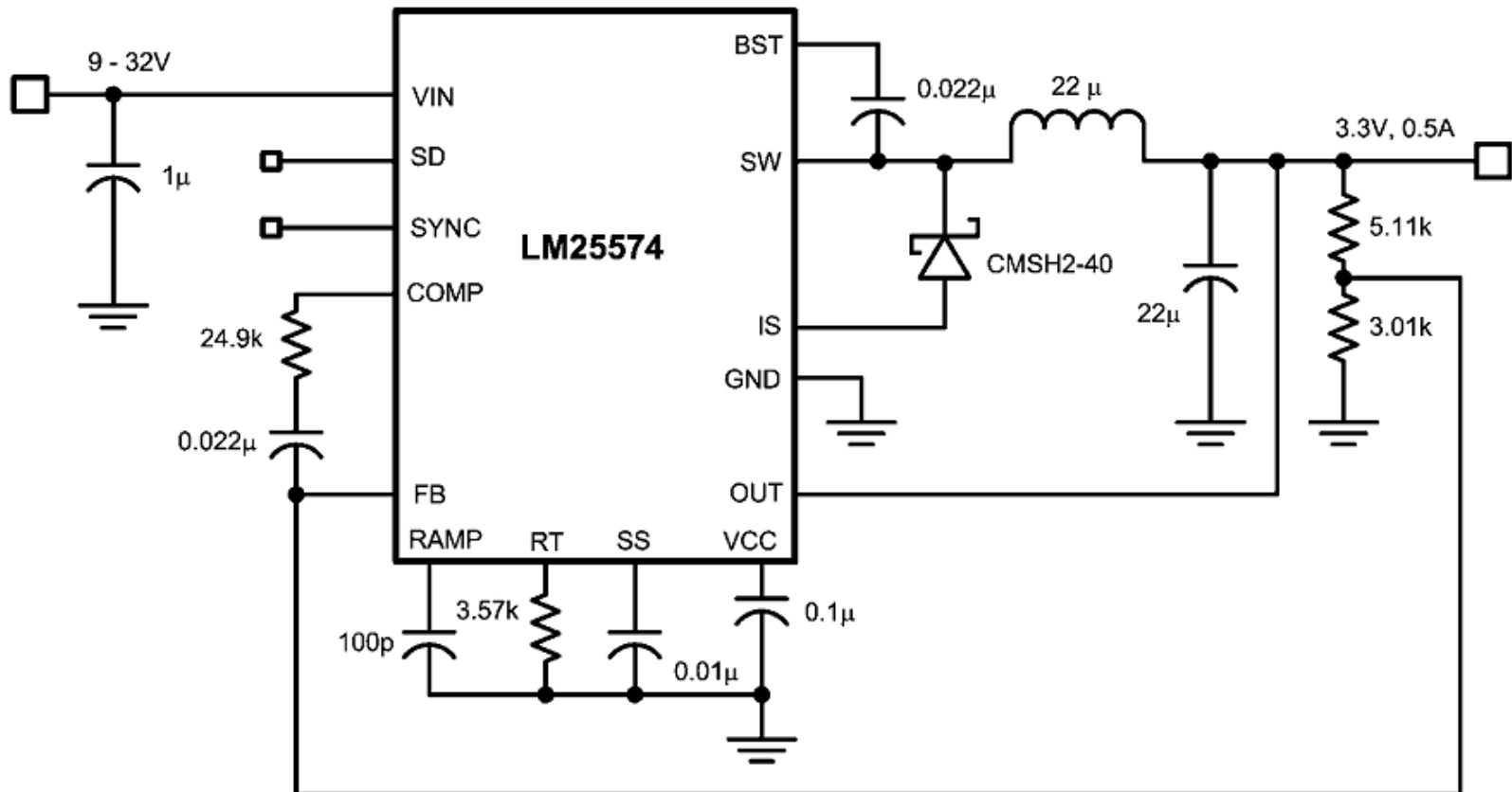
LM2621 Typical Application



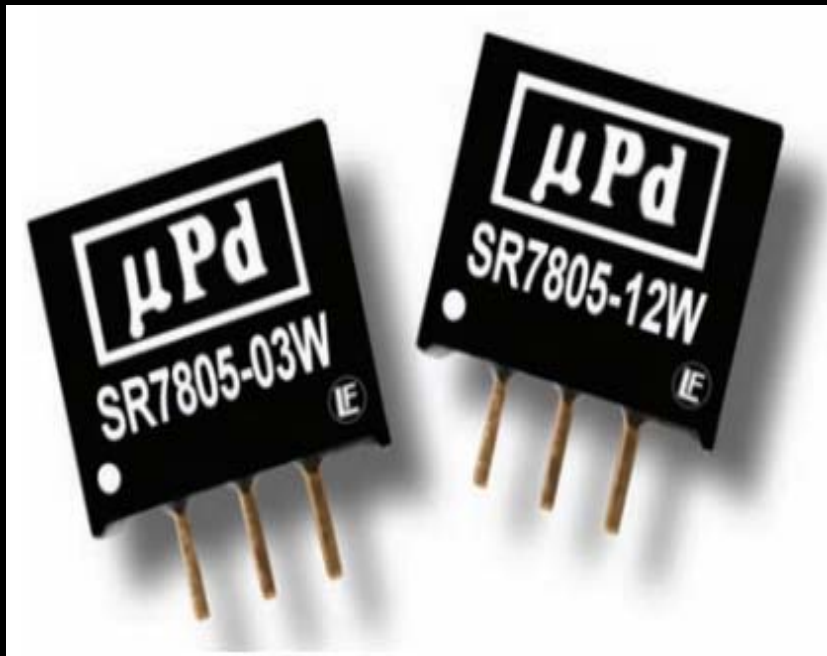


LM25574

- LM25574 – Step Down Regulator
 - Integrated 42V, 750 m Ω N-Channel Mosfet
 - Wide input voltage range from 6V to 42V
 - Adjustable output voltage as low as 1.225V

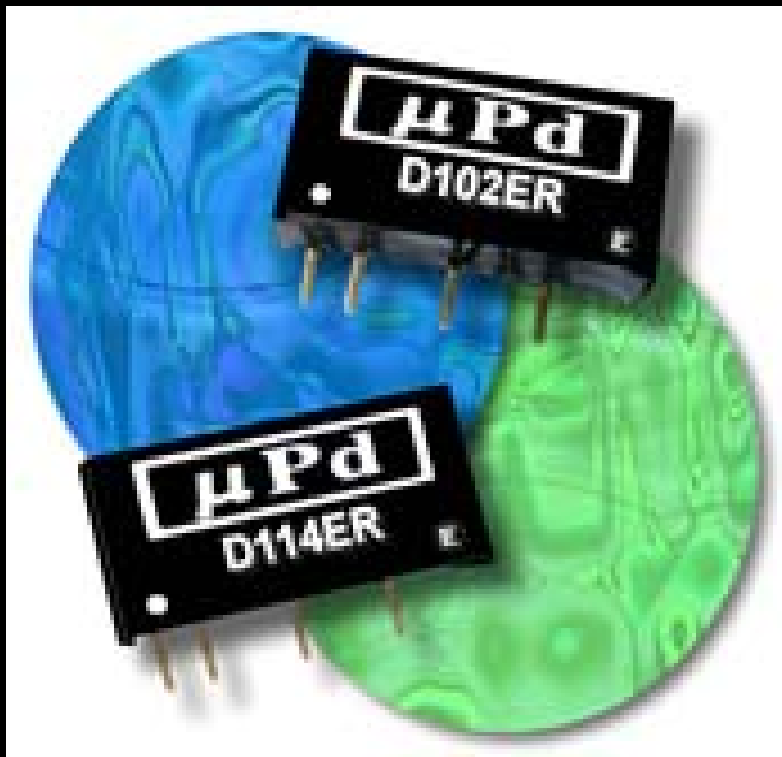


SR7805 Miniature Regulator



- SR7805-09W
 - To power 9V Units
 - Output Current 500mA
 - Input V Range 11-32V
 - Regulated Output.
 - Greater Efficiency and wide input voltage range

D111ER DC/DC Converter



- Regulated output Voltage
- Input Voltage Range
 - 11.4-12.6 V
- Output Voltage/Current
 - 5V
 - 150mA

MN:	Vin (Min)	Vin(Max)	Input Current (Amps)	Power Watts
Garmin GPS GPS15L	3.3	5.4	0.085	2.805-4.59
Garmin GPS GPS15L	3.3	5.4	0.085	2.805-4.59
Garmin GPS 25-lvs	3.6	6.0	0.12	0.432-0.72
Microtrak 300	9.0	15.0	0.18	1.62-2.7
Basic Stamp v2.2	5.0	15.0	0.003	0.015-0.045
Servo	12.0	12.0	0.5	6.0
Cutter	12.0	14.0	.02	0.24-0.28

Model Number	Weight (Oz)	Current Power Source (mA)	Current Weight of Power Source	Mission Criticality
Garmin GPS GPS15L	0.5	3 AA battery 4.5V	0.276 lb	High
Garmin GPS GPS15L	0.5	3 AA battery 4.5V	0.276 lb	High
Garmin GPS 25-lvs	1.3	4 AA battery 6V	0.150 lb	High
Basic Stamp v2.2	1.85	9V	0.080 lb	High
Microtrak 300	1.15	9V	0.080 lb	Medium
Servo	1.25		0.078 lb	Low
Cutter				Low

Tasks

- Approval of design
- Advisors approval to order parts
- Start testing
- Debugging systems for maximum efficiency
- Final report

Conclusion

- HIBAL – What is HIBAL?
- Our main objective and solution
 - Centralized Power bus system
- Battery
- Micro-converters, voltage converters

Contact Information

- Todd Rogers (rogers.17@wright.edu)
- Aoun Barki (barki.2@wright.edu)
- Henok Feseha (fescha.2@wright.edu)
- www.engineering.wright.edu/balloon/index.php/main_page

– ANY QUESTIONS?