ELECTRICAL SYSTEMS OF THE ELECTRIC MOTORCYCLE

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DEPARTMENT OF ENGINEERING

the Collaboratory
for strategic partnerships and applied research

Overview

- Project History/Background
- Motorcycle Electrical Systems Description
- This Year's Project Designs
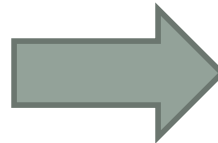- Proposed Implementation/Future Work

SCV Project History

- Began in 2006 as the Solar Commuter Vehicle Project
- Research project to explore feasibility of electric motorcycles
- Assembled from a Kawasaki Ninja motorcycle

Brushed DC Motor Conversion

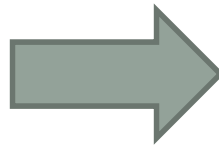- Gasoline engine to brushed DC motor with lead acid batteries.

Motor Upgrade

|	Brushed	Brushless
Rotor Movement Mechanism	Physical Contacts (Causing Mechanical Wear)	Induced Magnetic Fields from Control Circuitry
Efficiency	Decent	Better

Brushed Motor

Brushless Motor

More complicated but higher quality and more efficient

Battery Upgrade

	Lead-Acid	Lithium-Ion
Construction	Lead Dioxide (PbO_2)	Lithium Metal Ions
Performance/Maintenance	Undesirable	Desirable
Energy/Weight Ratio	Low	High
Applications	Non-weight, space critical applications (Car Starters)	Low weight, low space consumption

Lead-Acid
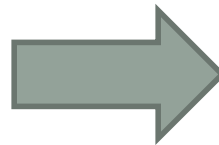
Lithium-Ion

Better Performance, High Energy Density

Current Power Systems Overview

Battery Pack
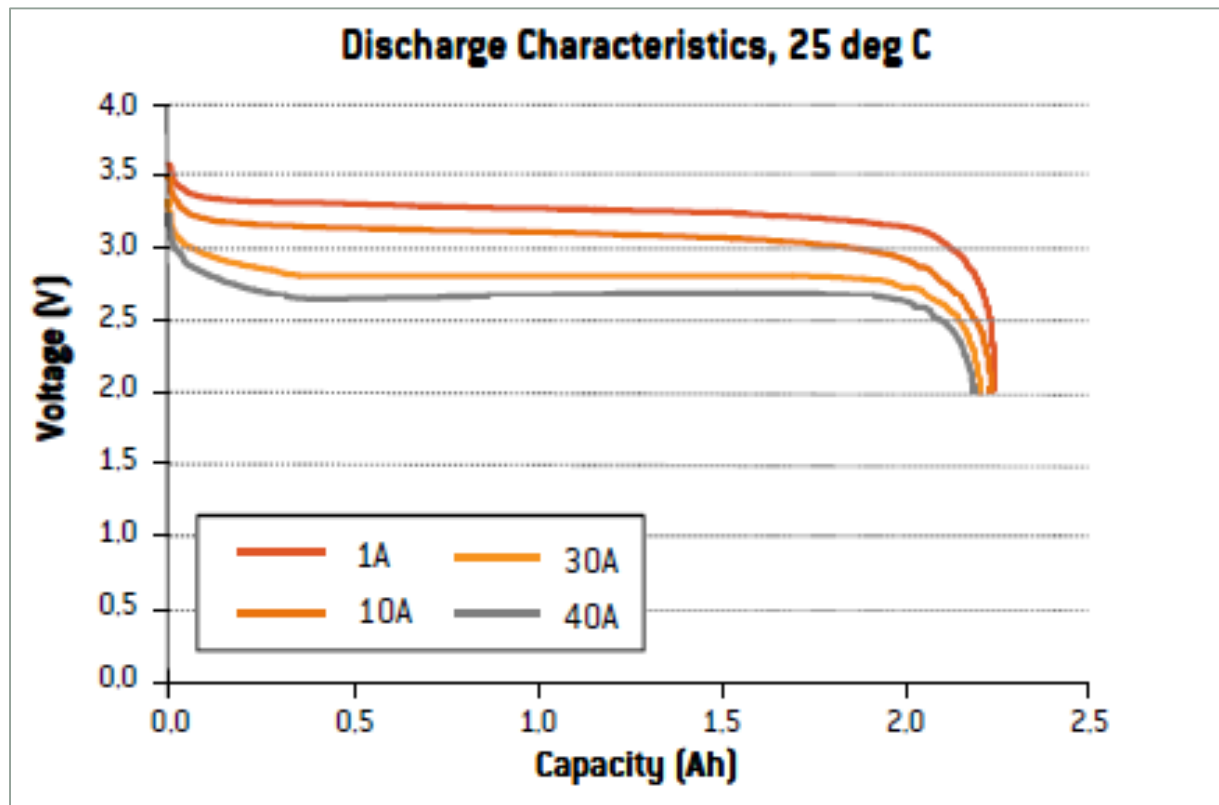

Stores and Delivers Charge

Motor Controller

Provides regulated battery pack energy to the motor

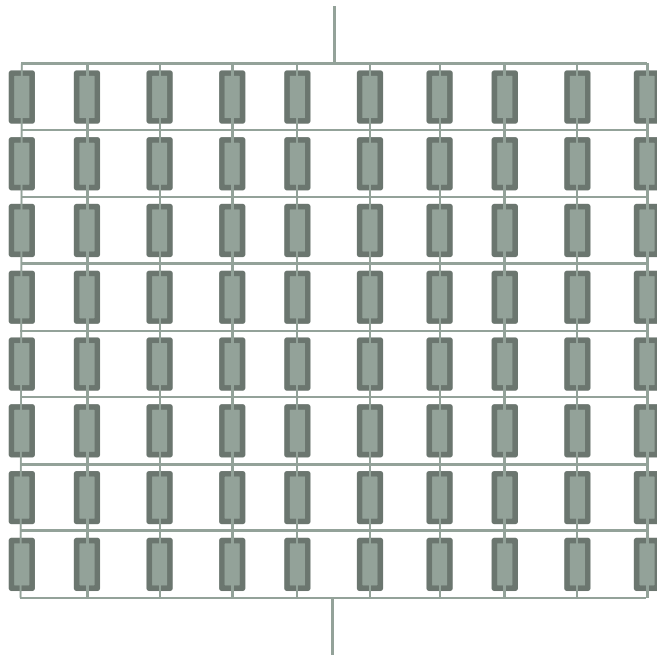**Motor**

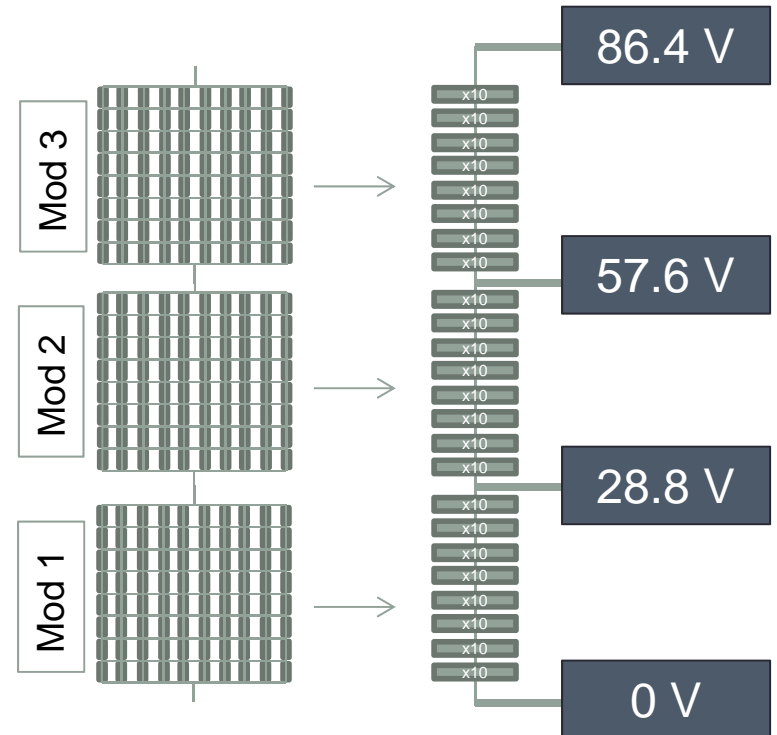# Our Batteries

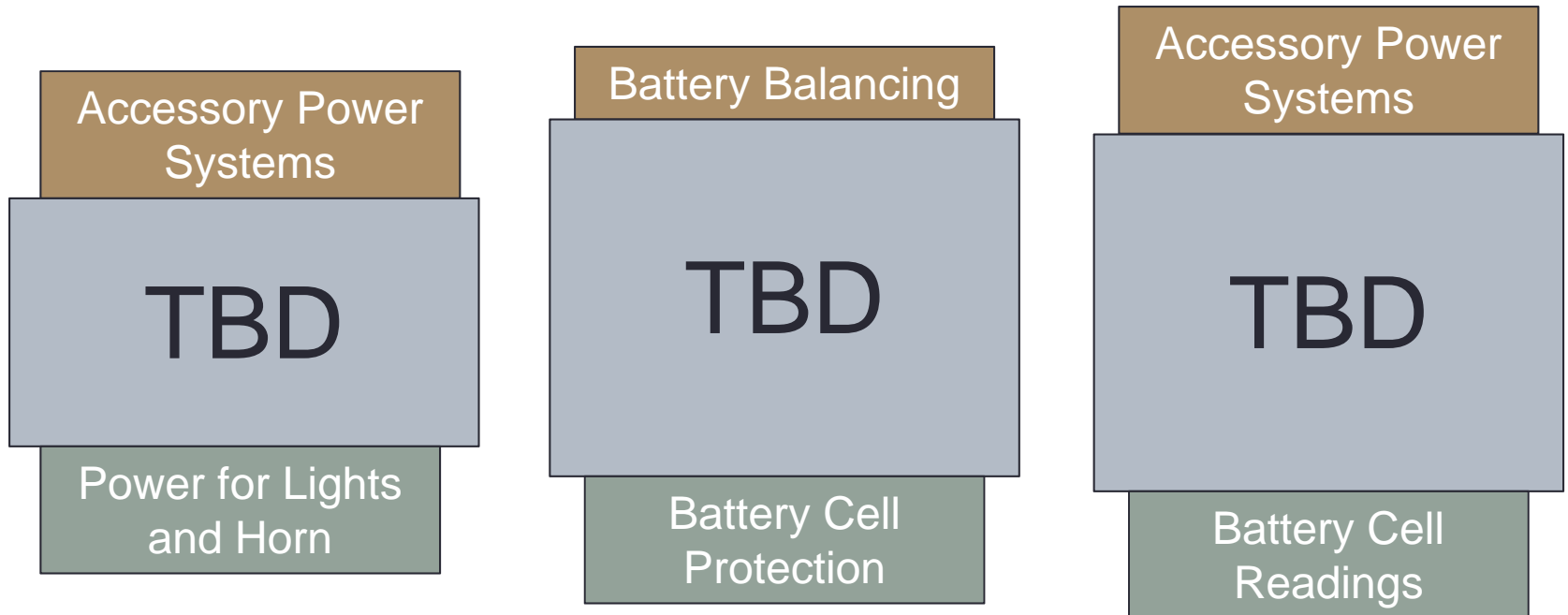- Operating Cell Voltage Range 2.5V-3.6V

Discharge Characteristics, 25 deg C

Our Battery Pack

Battery Module

20-28.8V

Battery Pack

86.4 V

57.6 V

28.8 V

0 V

Mod 3

Mod 2

Mod 1

x10 (repeated)

Tasks

- To-Be-Designed (TBD) Projects for this year

Accessory Power Systems

TBD

Power for Lights and Horn

Battery Balancing

TBD

Battery Cell Protection

Accessory Power Systems

TBD

Battery Cell Readings

Accessory Power Outline

Battery Pack

60-86.4 V

Motor Controller

For High Voltage Motor

Accessory Power Systems

TBD

For Other Low Voltage Components

12 V @10A

Motorcycle Headlights, Tail Light, Horn
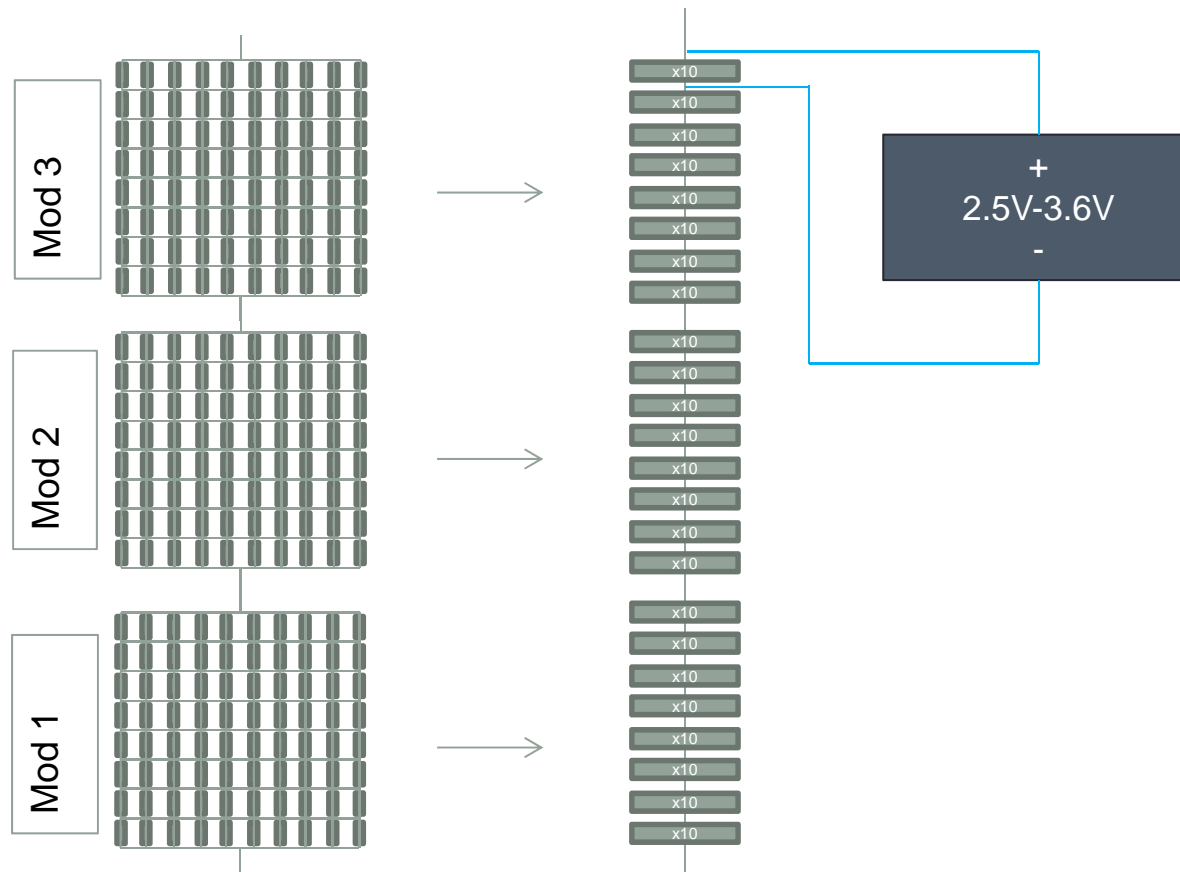
5 V

Microprocessors
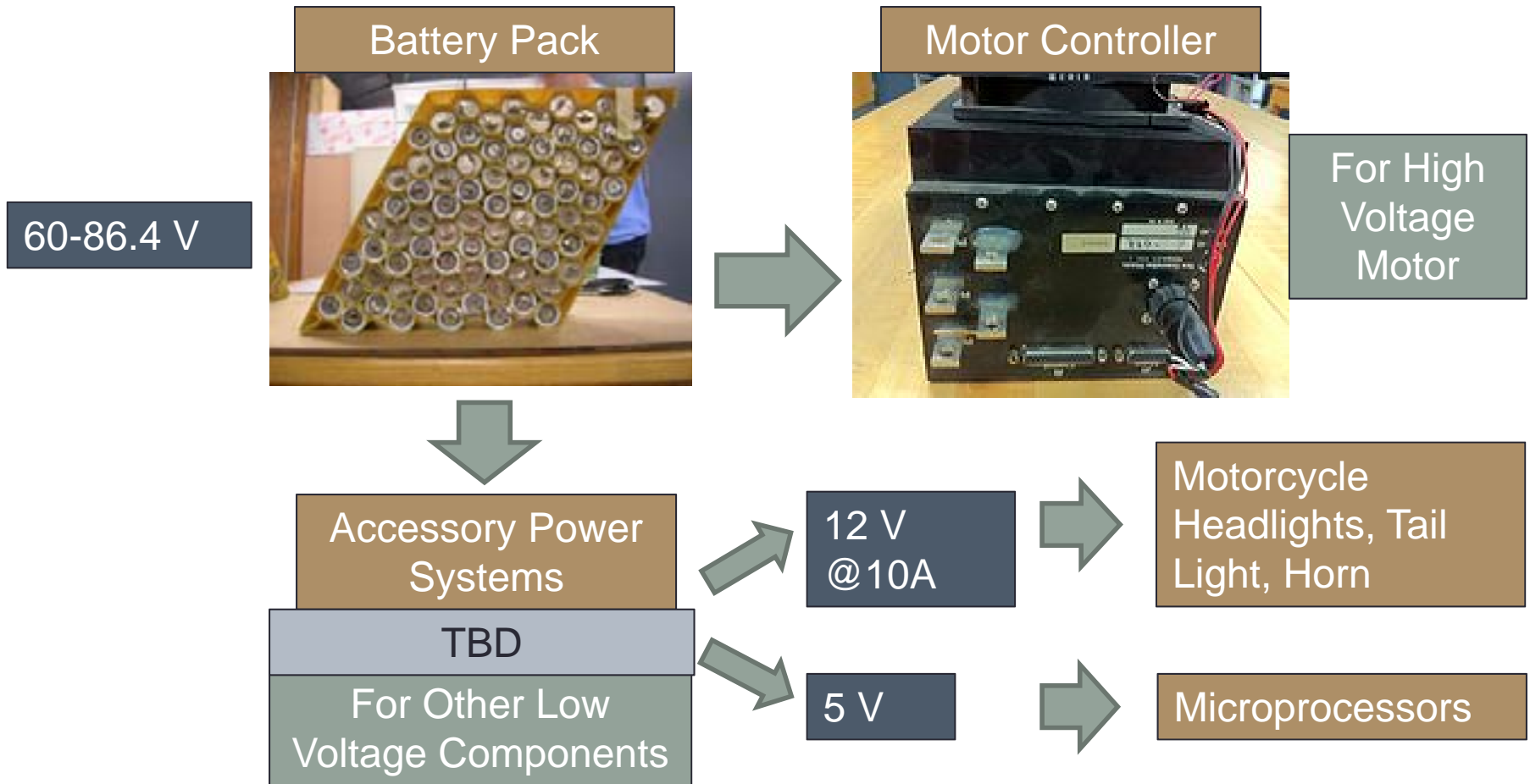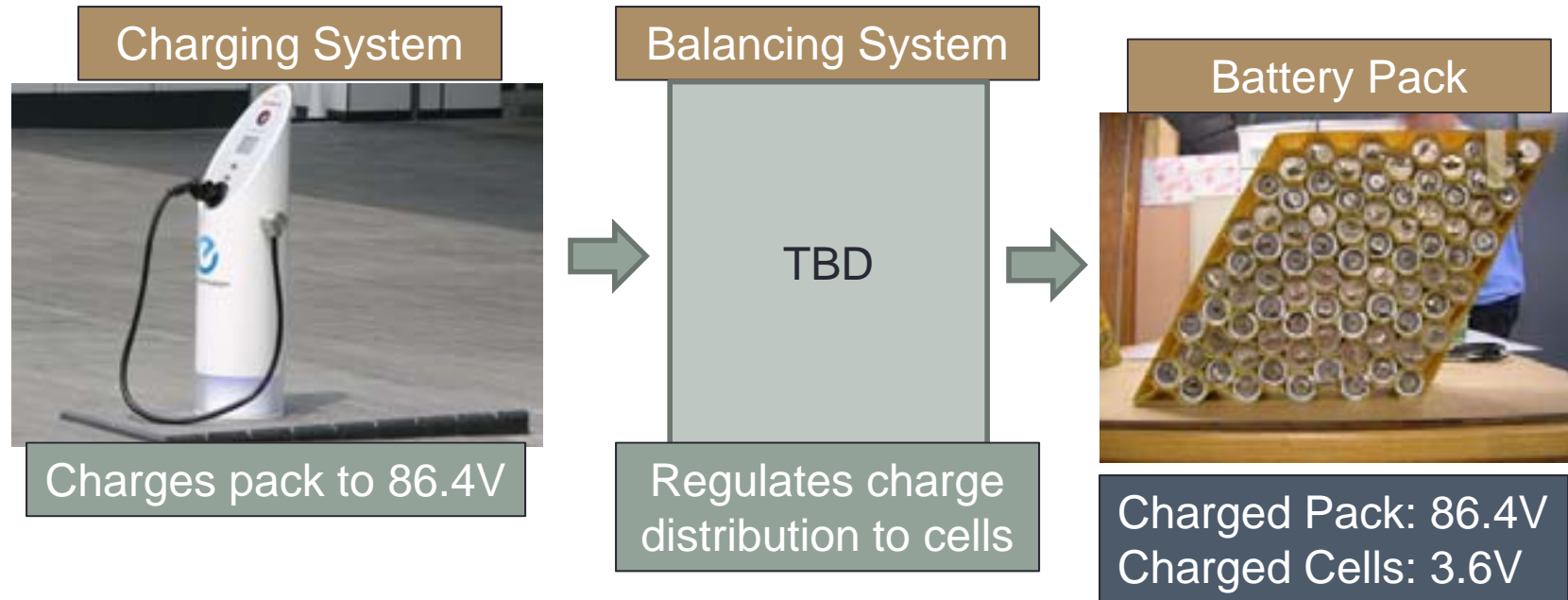
Accessory Power System Design

- Produces 12V and 5V from pack range: 60-86.4V and can deliver high current.

- Implemented Linear Technology LT3810 chip.

- Unresolved problems led us to seek commercial options.

Battery Balancing

- Circuitry needed to keep cell string voltages between 2.5V-3.6V while charging the pack to 86.4V

Battery Balancing Structure

Charging System

Charges pack to 86.4V

Balancing System

TBD

Regulates charge distribution to cells

Battery Pack

Charged Pack: 86.4V
Charged Cells: 3.6V

Battery Balancing

- Circuitry needed to keep cell string voltages between 2.5V-3.6V during charging.
- Texas Instruments Battery Balancing Chip selected
- Support circuitry designed.
- One chip per module
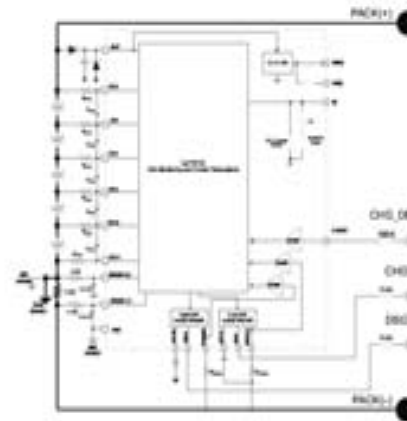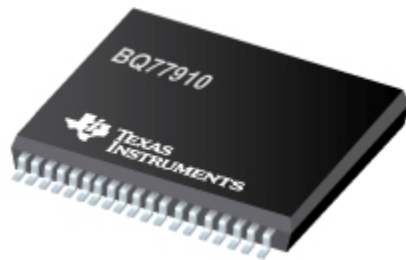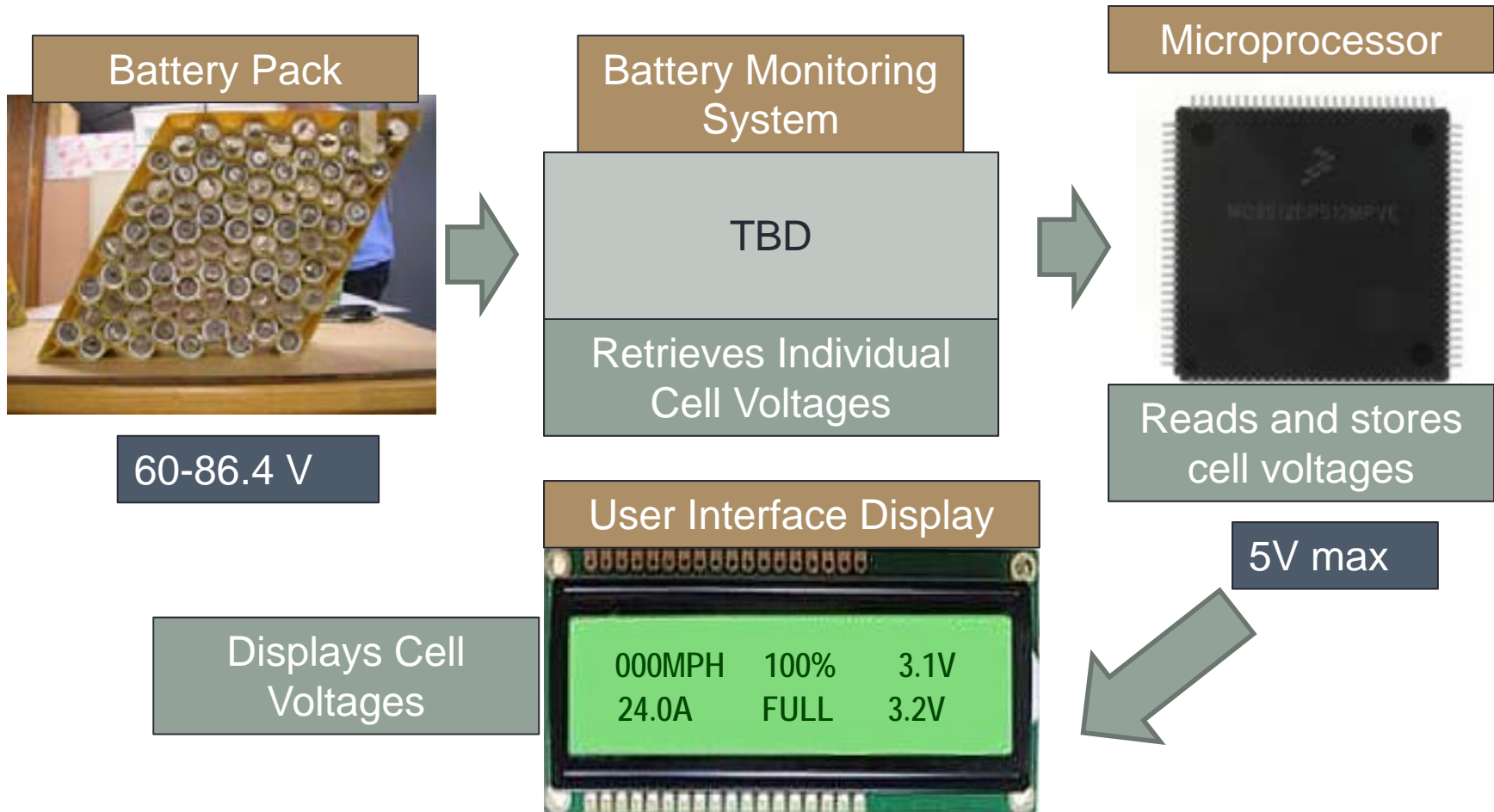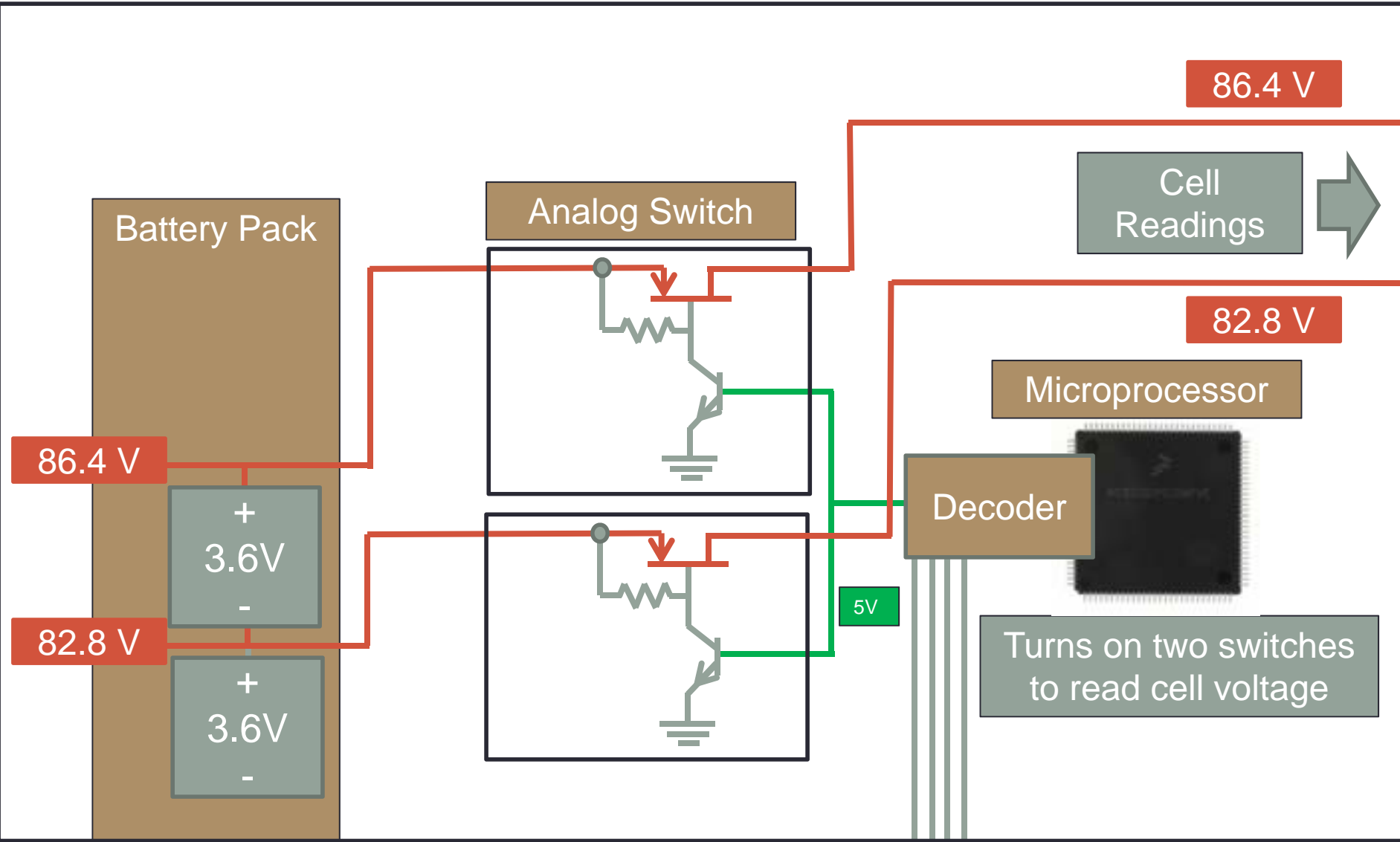- Programming Functionality

Figure 16. Single Power Path, No FETs

Battery Monitoring Structure

Battery Pack

60-86.4 V

Battery Monitoring System

TBD

Retrieves Individual Cell Voltages

Microprocessor

Reads and stores cell voltages

5V max

User Interface Display

000MPH   100%   3.1V
24.0A   FULL   3.2V

Displays Cell Voltages

Battery Balancing Cell Selection

Battery Pack

Analog Switch

Cell Readings

86.4 V

82.8 V

Microprocessor

86.4 V

+
3.6V
-

82.8 V

+
3.6V
-

Decoder

5V

Turns on two switches to read cell voltage

Battery Balancing Cell Selection

Other Switches

Battery Pack

Analog Switch

57.6 V

54 V

Cell Readings

Microprocessor

86.4 V

+ 3.6V -

82.8 V

+ 3.6V -

Decoder

5V

Turns on two switches to read cell voltage

Battery Balancing Cell Readings

86.4 V

Analog Switch

Cell Selector

82.8 V

Microprocessor

Decoder

Turns on two switches
to read cell voltage

Battery Balancing Cell Readings

Cell Selector

3.6 V

Analog Switch

0 V

Microprocessor

5V

Decoder

3.6 V

Turns on two switches to read cell voltage

Electrical Systems Structure
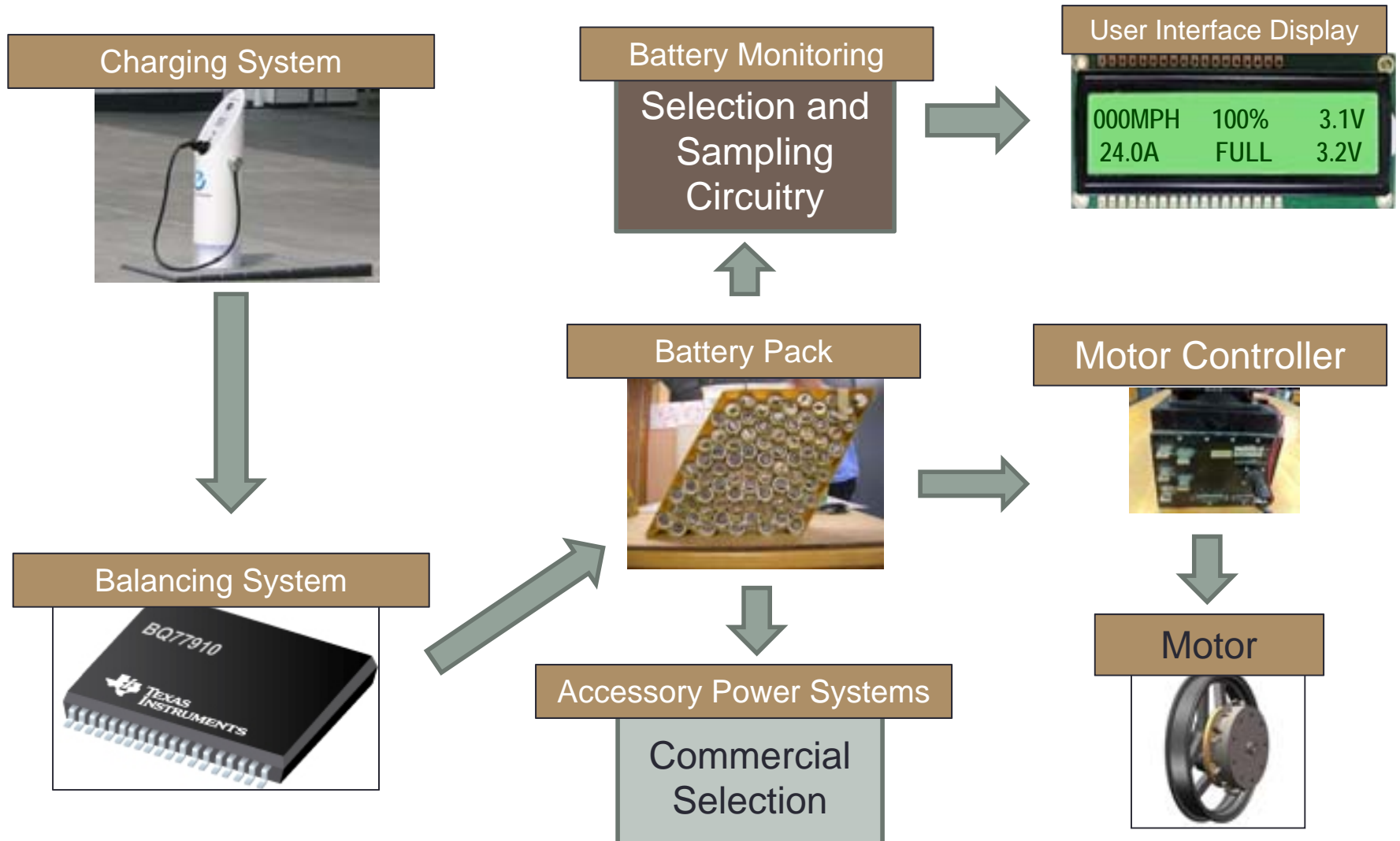
Thanks

- Dr. Pratt
- Paul Myers
- Predecessors:
  - Sara Finn
  - Eric Hornberger
  - Jon Wolgemuth