



AEVA

Welcome to the September 2009
meeting of the
Australian Electric Vehicle Association
Adelaide Branch

Battery Charging for EVs



AEVA Adelaide - September 2009

Eric Rodda



Battery Charging for EVs

AEVA Adelaide September 2009 – Eric Rodda

Welcome

In this presentation we will discuss ...

- The Future ?
- Using The Sun
- Public Charging Stations
- Battery Types
- Chargers for Traction Batteries
- Battery Management Systems
- Chargers for the Auxiliary Battery

Battery Charging for EVs

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Better Place video here:

YouTube - http://www.youtube.com/watch?v=9Bfz_x9e2Fo

Click above link if on-line...

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Project Better Place – Launched in late 2007

- Battery charging stations
- Battery swap stations
- Monthly subscriptions
- Working with car manufacturers eg. Renault/Nissan
- Operational in Australia (Canberra - 2012)
- Suitable for the home converter?

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www.betterplace.com

“We selected Australia, the world's sixth largest country, to show that our model works in any country, regardless of size. If Australia can do it, so can others. We will build an electric vehicle network capable of supporting the switch of Australia's 15 million gas cars to zero emission vehicles”

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Solar Charging Parking Stations



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Futuristic ?

“Solar Trees”



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The reality of using Solar Panels on your EV ... to charge the traction battery



A typical solar panel:

- Size – 1500mm x 800mm (1.2 square metres)
- Very expensive ~ \$1000 per panel
- Power output in full sun – 170 Watts
- Power required to charge a typical EV
 - 2,500 Watts; this would require 15 of the above solar panels
- Total solar panel area – 18 square metres.
- Total area of a typical car roof
 - less than 2 square metres

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NOT VIABLE WITH CURRENT SOLAR TECHNOLOGY

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Public Charging Stations

Some examples ...

- Westfield Shopping Centres in Sydney have dedicated parking places for electric car parking/charging
- McDonalds have charging in their car parks in at least three countries.
- Adelaide City Council are talking about having some of there car parks with charging facilities.
- Coulomb Technologies Chargepoints in San Jose, California USA

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Public Charging Stations - “ChargePoints”

ChargePoint video here:

YouTube - <http://www.youtube.com/watch?v=Sx5QlwvoRZ0>

Click above link if on-line...

San Jose, California USA

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Battery types used in EVs ... ?

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Battery types used in EVs

- **Lead Acid** – eg. SLA Deep Cycle, even flooded lead acid are still very popular in the US with home converters. Generally the smallest battery is 3 cells (6V).
- **NiMH** – used in some commercial hybrids eg. Toyota Prius. Not generally used in home conversions.
- **Lithium Ion** – Particularly **Lithium Iron Phosphate**. This is fairly new technology. The advantage here is much reduced weight for similar power density as Lead Acid. Also individual cells makes it easy to implement Battery Management Systems.

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Charging from the utility mains power supply eg. 230V AC

Charging system types:

- On-board – Installed permanently in the EV
- Off-board – Installed in garage or carport etc.



For ease of connection most people choose the “On-board” system, even though it adds extra weight to the EV. Why?

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“Opportunity charging” is only possible with an On-Board charger.

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On-board Chargers for Traction Batteries

EVALBUM (www.evalbum.com) shows that there are at least 135 different brands of chargers available for use in EVs. Most of these are not available in Australia



The following screens show some of the chargers that EV enthusiasts are purchasing in Australia...

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Woods Battery Chargers



EV.charge

6 stage "Intelligent" charger
for lead acid type batteries.

LEAVER INDUSTRIES
trading as
WOODS Battery Chargers Pty Ltd

Woods Battery Chargers is an Australian owned and operated manufacturing company. Woods Battery Chargers is owned by Leaver Industries, Australia.

Head Office:
110 Hoskins Street
Sandgate, QLD, 4017
Australia
Phn: 61 7 3269 3566
Fax: 61 7 3269 4315

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ZIVAN Battery Chargers – from Italy



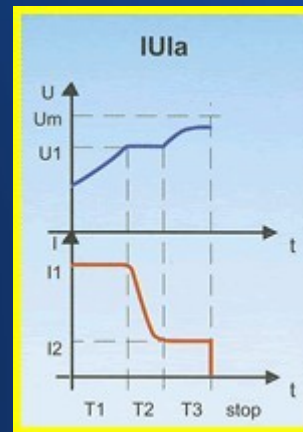
NG3 - up to 312 Volts

3 or 4 stage "Intelligent" charger.

"Many other charging profiles for specific battery types such as Flooded, Gel, AGM and Lithium Ion" *from Zivan website*

NG1 & NG3 Models available from:

- M&H Power Systems – Most states
- Electric Vehicle Motors - Sydney
- EV Works - Perth



NG1 - up to 48 Volts

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Delta-Q Battery Chargers from Canada

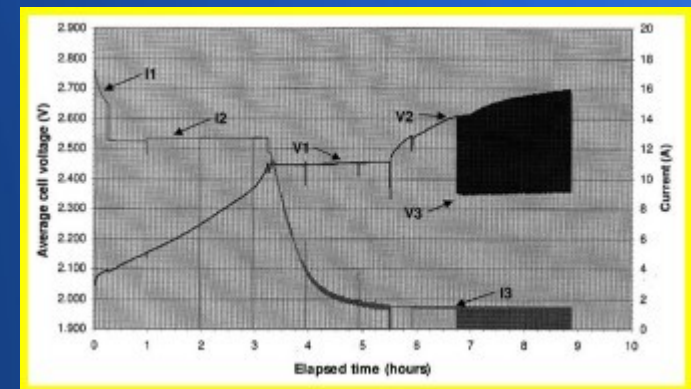


QuiQ Charger

Multi-stage “Intelligent” charger for
Sealed Lead Acid type batteries.
Programmed with multi-algorithms.

QuiQ Charger by Delta-Q
available from:
Advance Trident Ltd. - QLD

Tel: 07 3390 6900
Fax: 07 3390 6911
Unit 10
Manly Marine World,
1029 Manly Rd
Tingalpa
QLD 4173



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Using individual chargers on each battery



eg. Jaycar MB3612 Charger:
POWERTECH
12V, 6 or 12Amps

Advantages:

- Each battery's charge is optimised
- Relatively low cost
- Intelligent charger

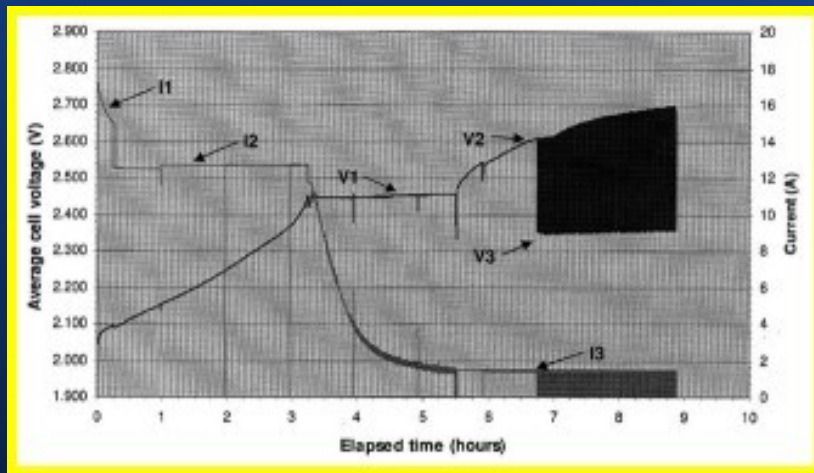
Disadvantages:

- Often require modification for series battery connections
eg. (-)ve O/P earth connection
- Cooling fan reliability?

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What is an “Intelligent Charger” ?



Delta-Q QuiQ Charger plot

Microprocessor controlled
programmable charging
systems.

An “Intelligent Charger” is a multi-stage charging system.

Often the stages are:

- **Constant current** charge set up to maximum current for battery.
- **Constant voltage** stage while charge current drops.
- **Constant current** stage (low current) to allow the battery to reach it's maximum voltage.
- **Equalisation** stage (often pulsed)

Battery Charging for EVs

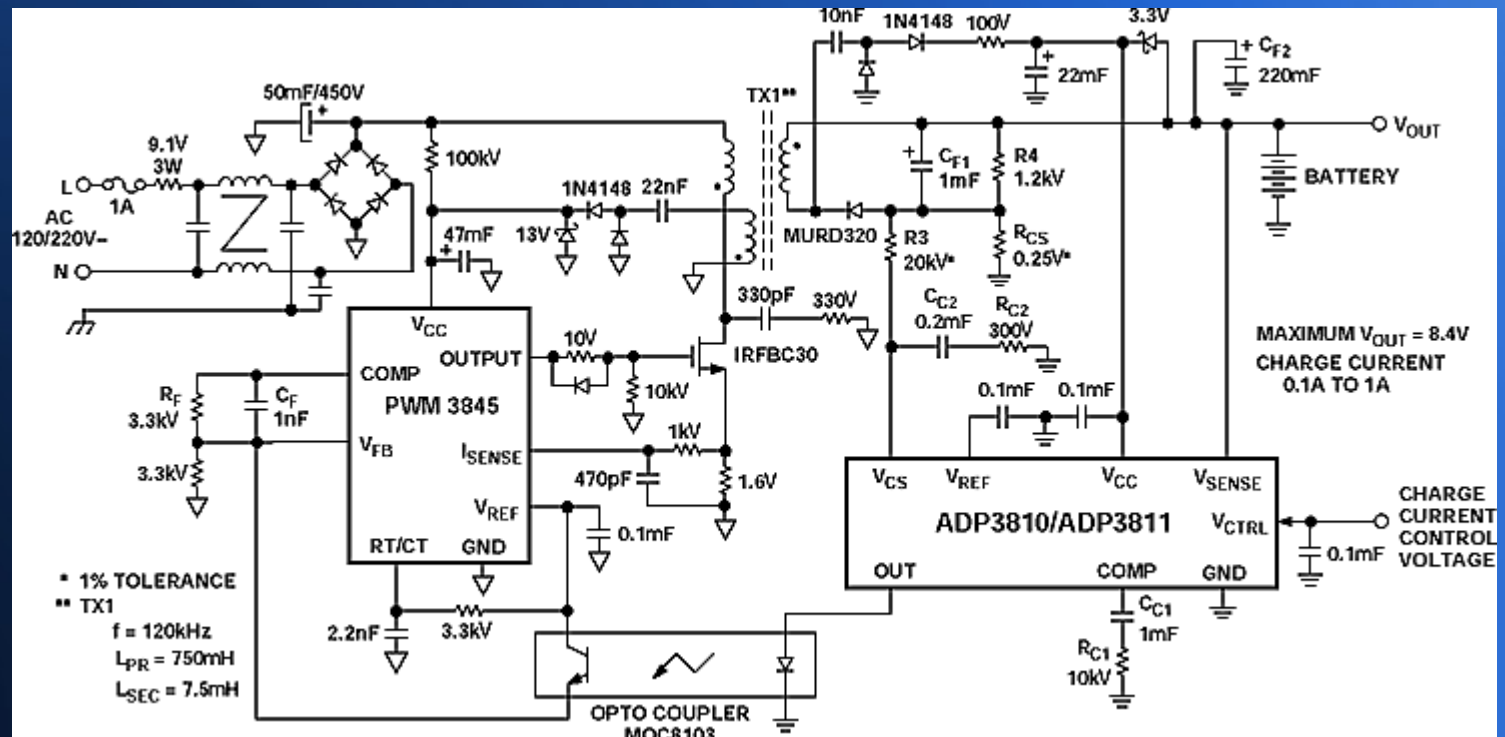
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What is in an “Intelligent Charger” ?

Microprocessor
controlled
programmable
charging systems.

Efficiency of
85 - 90%

“Switch Mode” or
“Switching Mode”
power supply.



Switch Mode power supply example.

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Powering your charger...

Your traction battery charger may require a special power outlet to be installed in your garage or carport.

The reason for this is the fact that because of the charging power requirements, the charger input rating at 230V AC may have a current rating above that of the standard household power outlet: (10Amp)

The AC input requirement should be on the charger specification plate or in the information book.

You may be able to ask your electrical authority (ETSA Utilities in SA) if you can connect your EV Charger to the **reduced night rate** (J Tariff) on your switchboard. This will definitely require a special (round pin) outlet.

Discuss all these things with your electrician.

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Batteries & Cells, What is the difference?

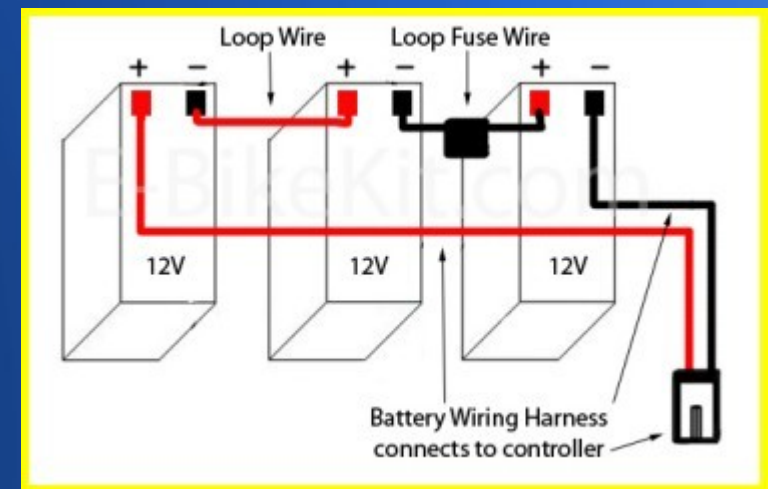
To produce the required voltage for the traction battery, many individual batteries or cells have to be connected in series.

Lead acid batteries usually come in the following sizes:

- 6 Volt (3 cells)
- 8 Volt (4 cells)
- 12 Volt (6 cells) ... all nominally 2V per cell

Note, that with these batteries, there is usually no way to be able to access the individual cells.

Lithium Iron Phosphate are supplied as individual cells (nominally 3.2Volts)



Battery Charging for EVs

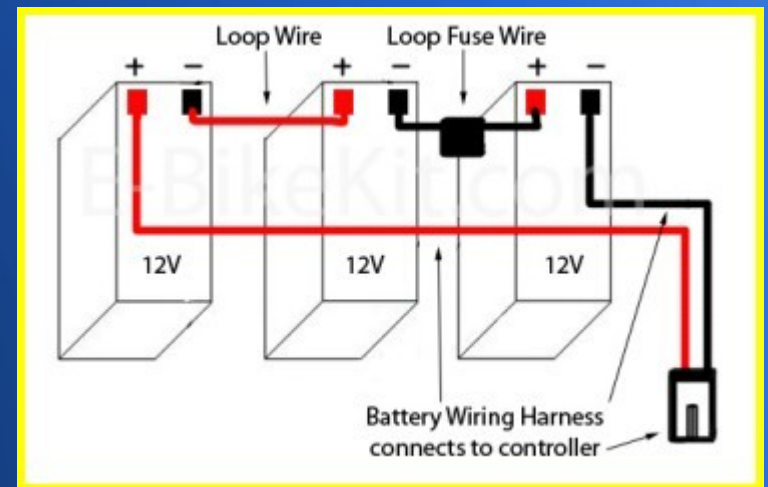
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Battery Management System (BMS)

Why the need for BMS?

The charger normally supplies charge current to the complete traction battery without any control over what happens to each battery or cell in the series string.

Because every battery or cell may have slightly different characteristics, some batteries or cells may charge faster than others, resulting in some overcharging and others being undercharged.



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Battery Management System (BMS)

What does the BMS do?

The BMS is designed to assist in equalising all of the cells or batteries in the series string of the traction battery.

For multi-cell batteries (as discussed previously) the equalisation will not occur at cell level but at the battery level (3, 4 or 6 cells). You are relying on the manufacturer to match the cells at the time of construction.

Each BMS module will be connected across each individual cell or battery.

A good BMS will monitor the cells/batteries on charge and discharge.

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Battery Management System (BMS)

Why is the BMS so important?

On charge it is imperative to stop the charge current when the first cell/battery in the string reaches the maximum allowable voltage, thus preventing overcharge.

Some BMS' will also, at a set voltage, cause some bypassing action, which due to the design of the BMS will cause a current to flow through the BMS module itself. This effectively lowers the current that will pass through that cell/battery, allowing the other cells /batteries to receive the full charge current.

On discharge, if a cell/battery voltage level falls below a preset level, the BMS module will cause an alarm or send a signal to the motor controller to reduce the load on the battery.

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Battery Management System (BMS)

Lithium Iron Phosphate



BMS CELL MODULE



TS90 MASTER CONTROL UNIT

EV WORKS

www.evworks.com.au - Western Australia

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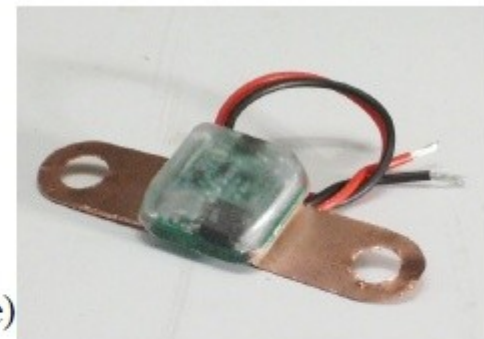
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Battery Management System (BMS)

Lithium Iron Phosphate

Cell Module Specifications

Cell Voltage:	3.2V nominal
Bypass Voltage:	3.63V (Bypass shunt will switch on)
Max. Bypass Current:	600mA
Weight:	30g
Power Consumption:	~3mA @ 3.2V
LED Indicators:	Green (ON=OK), Red (ON=Bypass active)
Safety Limits:	$2.5V < OK < 4.1V$
Optoisolator Output:	NC when cell voltage is within Safety Limits. Open otherwise.
Max signal current:	100mA
Epoxy encapsulated against dust and moisture ingress.	
Standard sizes available for TS LFP40/60AHA, LFP90AHA, LFP160AHA, LFP200AHA	



www.evworks.com.au - Western Australia

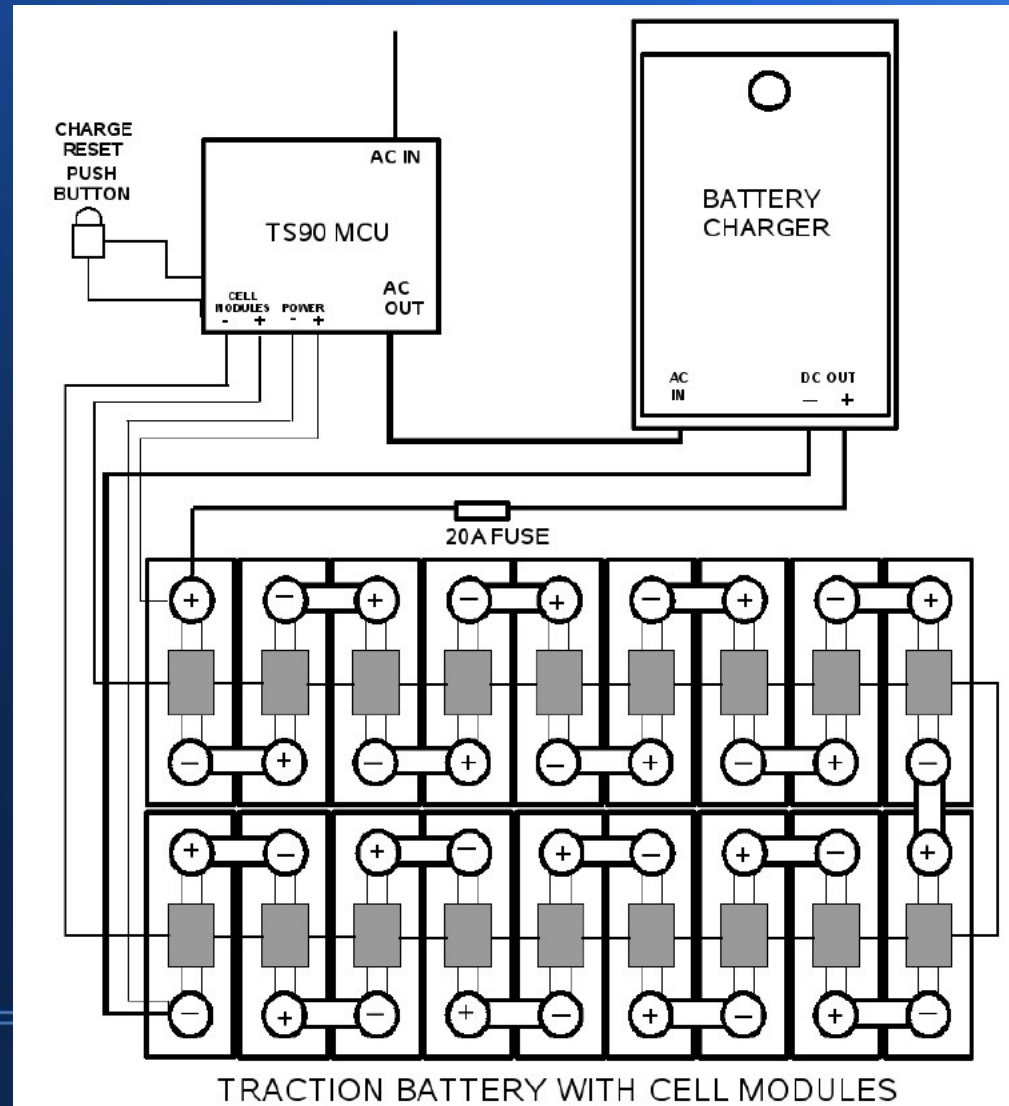
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Battery Management System (BMS)

Lithium Iron Phosphate

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Battery Management System (BMS)

Lead Acid

Multi-cell batteries such as all varieties of Lead Acid can also use Battery Management Systems.

A popular type is the Rudman Regulator...

designed by Joe Smalley of Manzanita Micro is sold by Rick Rudman, E-Car and others.

Rudman Regulators come in many versions. All of them offer two basic functions. They sit on top of a battery and clamp its voltage to some maximum, keeping it from being overcharged. This is accomplished by shunting power through a resistor on the regulator. They also optionally send a signal back to a Manzanita Micro battery charger (or other charger) telling the charger to cut back its current because one or more batteries can't accept this level of charging current.

There are many 'copies' of the Rudman Regulator principle available.

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Battery Management System (BMS)

Lead Acid

Other BMS systems include:

- BatPro
- Zivan Smoother
- Lee Hart Battery Balancer
- ...and others

Some BMS systems also send back temperature information for each battery or cell to control the charger accordingly.

If an over temperature signal is received, the charger turns off.

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Chargers for the Auxiliary Battery

Methods of charging the auxiliary battery:

- On-board mains powered battery charger which is switched on when the traction battery is charged.
- DC-DC converter powered from the traction battery.
- Solar panel trickle charger.
- ... any combination of the above.



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Home of the “White Zombie”

EV Juice Bar video here:

YouTube - <http://www.youtube.com/watch?v=ru4-2QRXwPQ>

Click above link if on-line...

Portland, Oregon USA

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Question time...



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