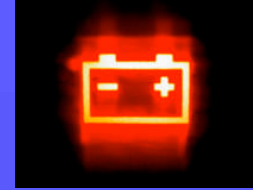


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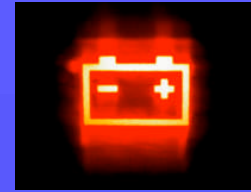
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Adding a Battery to



Battery Monitor

% Battery Cap Indication



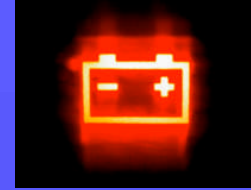
BatteryMonitor

- Stores up to 8 batteries to show % remaining battery capacity
- Battery terminal voltage is used to determine % remaining capacity
- Uses a 0,2,5,10,20,30,40,50,60,70,80,90,99 % readout

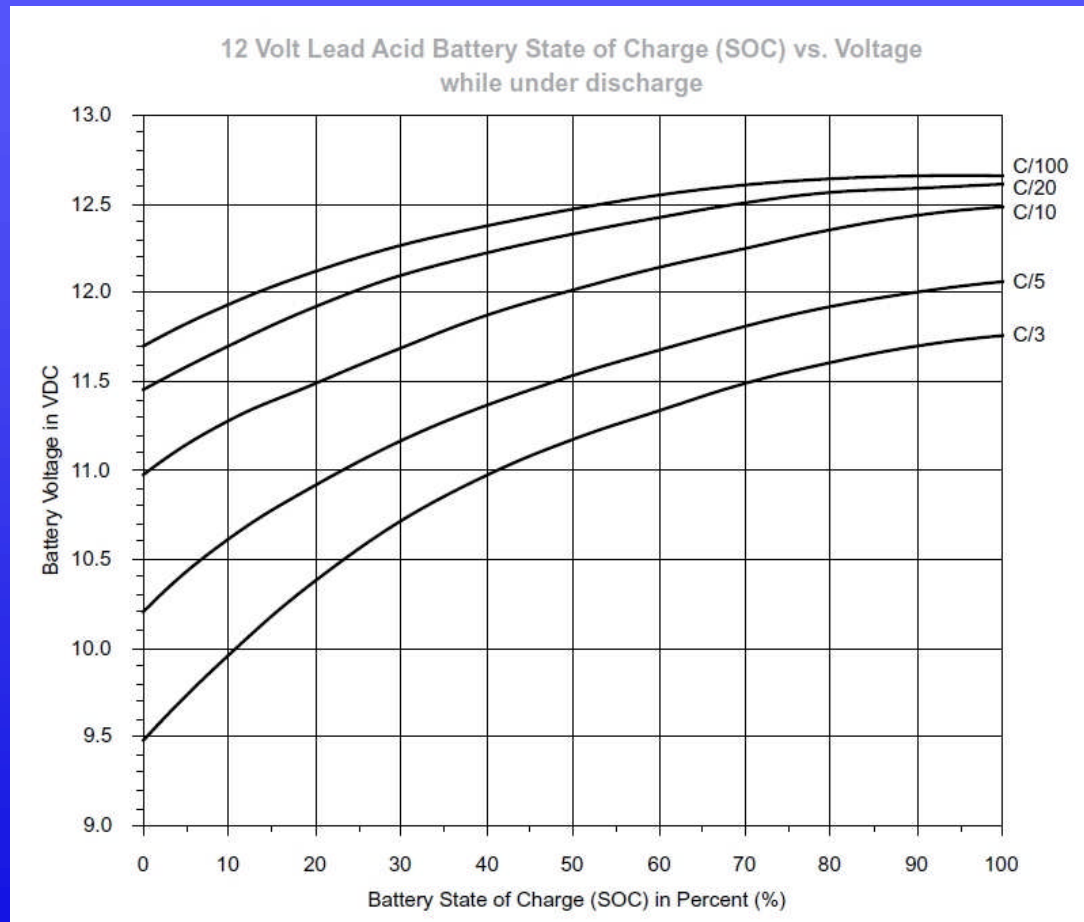
Caveats

- Consider this data to be only a general indication of battery condition
- The number is significantly influenced by battery internal resistance, load current, temperature, Peukert Effect

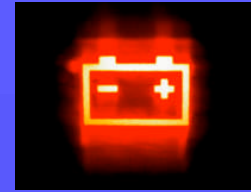
% Battery Cap Indication



Caveats: Battery Capacity versus discharge rate



Process to Add a Battery



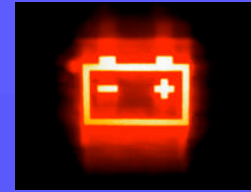
Battery should be in good shape

- It's a waste of time characterizing an almost dead battery

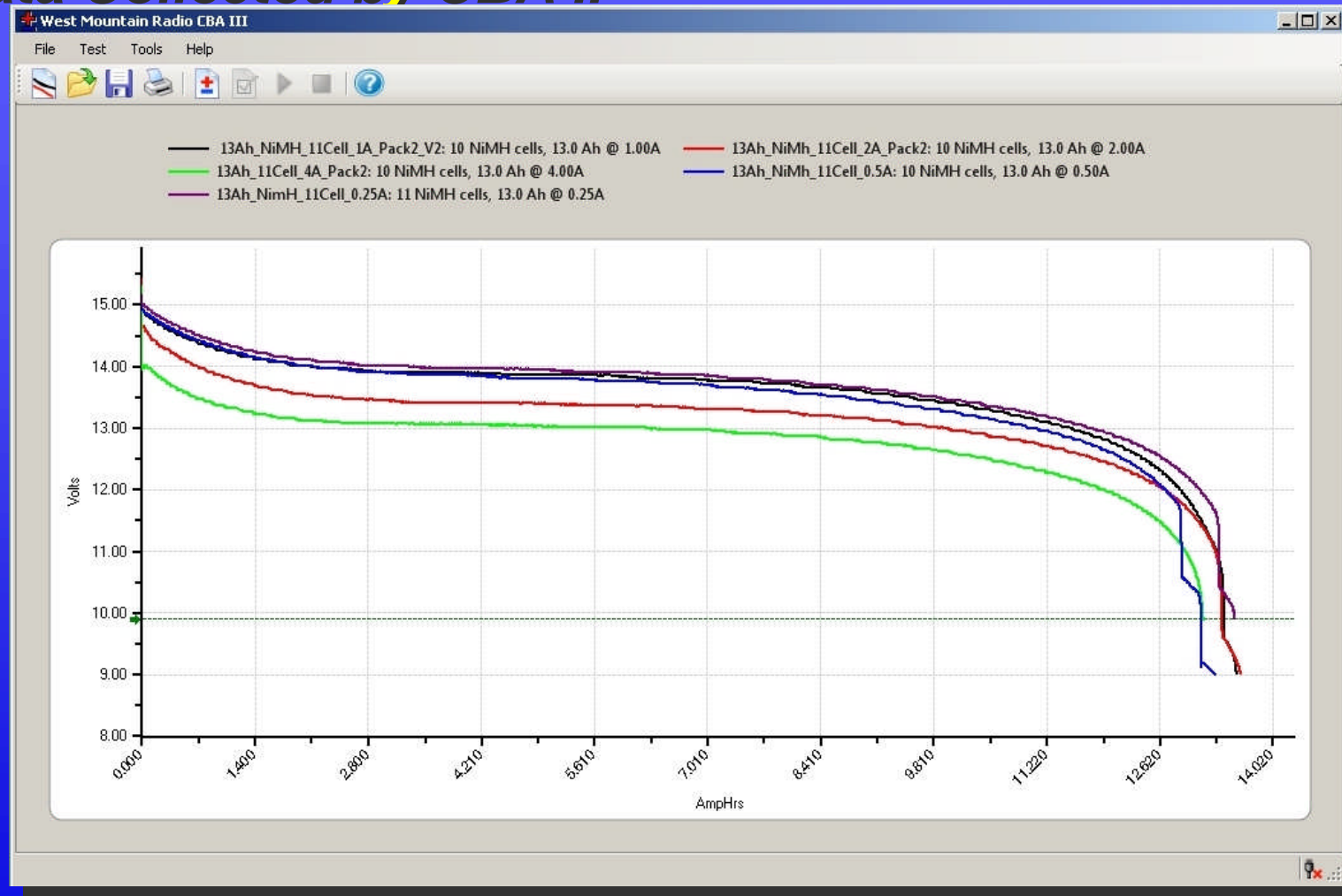
Gather data by characterizing the battery

- Best results are obtained if battery data is derived from battery characterization
 - Use a battery analyzer such as Power Werx CBA II or CBAIII
- Published battery capacity versus terminal voltage can be used but often will produce less accurate results
 - Data usually not provided in the same % increments as used by BatteryMonitor so interpolation will usually be needed
 - Open circuit terminal voltage data most often provided so behaviour under load not included
 - There's a significant variation in data published on the internet

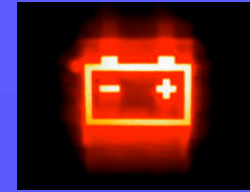
Analyze & Summarize Data



Data Collected by CBA II



Analyze & Summarize Data



**CBA file
exported
to CSV**

Microsoft Excel - 13Ah_NiMH_11Cell_4A_Pack2.csv

File Edit View Insert Format Tools Data Window Help PDF Create! Type a question for help

Arial 10 B I U

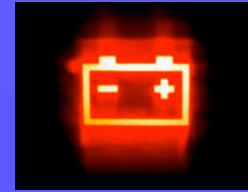
A5 13.00 Ah

	A	B	C	D	E	F	G	H	I
1	Date	Time	Test Total Time						
2	09/27/10	07:39:10	(hh:mm:ss): 3:05:32						
3									
4	Rated Capacity	Tested Capacity							
5	13.00 Ah	13.16 Ah							
6									
7	Cells	Battery Type	Battery Weight						
8	10	NiMH	5.000 kg						
9									
10	Test Current	Graph Type							
11	4.000 Amps	AmpHrs							
12									
13	Test	Time	Voltage	Current	Temp (C)				
14	13Ah_11Cell_4A_Pack2	0	15.32	0.043	0				
15	13Ah_11Cell_4A_Pack2	1	14.27	1.703	0				
16	13Ah_11Cell_4A_Pack2	2	14.04	3.393	0				
17	13Ah_11Cell_4A_Pack2	3	13.98	3.994	0				
18	13Ah_11Cell_4A_Pack2	4	13.93	4.218	0				
19	13Ah_11Cell_4A_Pack2	5	13.92	4.319	0				
20	13Ah_11Cell_4A_Pack2	6	13.96	4.297	0				
21	13Ah_11Cell_4A_Pack2	7	13.98	4.24	0				
22	13Ah_11Cell_4A_Pack2	8	13.99	4.236	0				
23	13Ah_11Cell_4A_Pack2	9	14.02	4.236	0				

13Ah_NiMH_11Cell_4A_Pack2

Ready

Analyze & Summarize Data



**CSV file
converted to
XLS format**

Microsoft Excel - 13Ah_NiMH_11Cell_4A_Pack2.xls

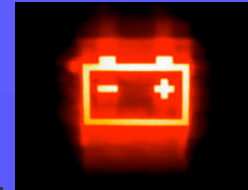
File Edit View Insert Format Tools Data Window Help PDF Create! Type a question for help

A7914 13Ah_11Cell_4A_Pack2

	A	B	C	D	E	F	G	H	I
1	Date	Time	Test Total Time						
2	09/27/10	07:39:10	(hh:mm:ss): 3:05:32						
3									
4	Rated Capacity	Tested Capacity							
5	13.00 Ah	13.16 Ah							
6									
7		Cells	Battery Type	Battery Weight					
8		10	NiMH	5.000 kg					
9		Cutoff	11	Volts					
10			1.0	Volts/Cell					
11	Test Current	Graph Type							
12	4.000 Amps	AmpHrs							
13									
14	Test	Time	Voltage	Current	Temp (C)	Ah	%Cap		
15	13Ah_11Cell_4A_Pack2	0	15.32	0.043	0	0.000	100%		
16	13Ah_11Cell_4A_Pack2	1	14.27	1.703	0	0.000	100%		
17	13Ah_11Cell_4A_Pack2	2	14.04	3.393	0	0.002	100%		
18	13Ah_11Cell_4A_Pack2	3	13.98	3.994	0	0.003	100%		
19	13Ah_11Cell_4A_Pack2	4	13.93	4.218	0	0.005	100%		
7910	13Ah_11Cell_4A_Pack2	7895	12.72	4.258	0	9.338	28%		
7911	13Ah_11Cell_4A_Pack2	7896	12.71	4.258	0	9.339	28%		
7912	13Ah_11Cell_4A_Pack2	7897	12.73	4.258	0	9.340	28%		
7913	13Ah_11Cell_4A_Pack2	7898	12.72	4.258	0	9.342	28%		
10888	13Ah_11Cell_4A_Pack2	10873	11.15	4.258	0	12.860	1%		
10889	13Ah_11Cell_4A_Pack2	10874	11.15	4.258	0	12.862	1%		
10890	13Ah_11Cell_4A_Pack2	10875	11.15	4.253	0	12.848	1%		
10891	13Ah_11Cell_4A_Pack2	10876	11.15	4.258	0	12.864	0%		
10892	13Ah_11Cell_4A_Pack2	10877	11.15	4.258	0	12.865	0%		

Ready Sum=0

Analyze & Summarize Data



**Summarize XLS
data for each
battery load
current**

Microsoft Excel - BatteryMeasurementSummary.xls

File Edit View Insert Format Tools Data Window Help PDF Create!

Arial 10 B I U

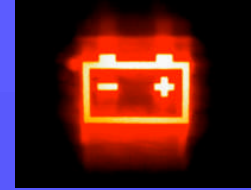
122

	A	B	C	D	E	F	G
1	5.2Ah 4 cell LiPo						
2	% Cap	4A	2A	1A	0.5A	.25A	
3	90	15.63	15.93	16.13	16.22	16.27	
4	80	15.43	15.76	15.95	16.07	16.12	
5	70	15.28	15.59	15.81	15.92	15.97	
6	60	15.11	15.43	15.65	15.77	15.82	
7	50	14.94	15.27	15.47	15.58	15.62	
8	40	14.78	15.10	15.28	15.42	15.43	
9	30	14.58	14.92	15.12	15.25	15.27	
10	20	14.36	14.72	14.87	15.01	15.05	
11	10	13.87	14.26	14.56	14.71	14.71	
12	5	13.47	13.81	14.16	14.40	14.26	
13	2	13.01	13.29	13.56	14.01	13.73	
14	0	12.35	12.53	12.72	12.73	12.72	
15	% Cap Rounded to one digit						SL Entry
16	90	15.6	15.9	16.1	16.2	16.3	16.2
17	80	15.4	15.8	16.0	16.1	16.1	16.1
18	70	15.3	15.6	15.8	15.9	16.0	15.9
19	60	15.1	15.4	15.7	15.8	15.8	15.8
20	50	14.9	15.3	15.5	15.6	15.6	15.6
21	40	14.8	15.1	15.3	15.4	15.4	15.4
22	30	14.6	14.9	15.1	15.3	15.3	15.2
23	20	14.4	14.7	14.9	15.0	15.1	15.0
24	10	13.9	14.3	14.6	14.7	14.7	14.7
25	5	13.5	13.8	14.2	14.4	14.3	14.4
26	2	13.0	13.3	13.6	14.0	13.7	13.8
27	0	12.4	12.5	12.7	12.7	12.7	12.7

SLA / NiMH / LiPo /

Ready

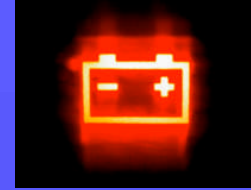
Adding a Battery (cont'd)



Adding data to the source code

- The PICAXE EEPROM contains the battery data. It's stored at the beginning of the source code in the EEPROM section
- At the beginning of each battery data set a comment line is used to indicate the battery number, zero through seven
- The first line contains fifteen characters between the quotes that describes the battery. It's used by the 'Select Battery' utility menu to describe the battery to the user
- The second line contains twelve voltage entries representing 2, 5, 10, 20, 30, 40, 50, 60, 70, 80, 90, & 99% battery capacity
- If the voltage entry is less than 10.0 volts the leading zero must be populated. For example 5.6 volts would appear as 056

Additional Resources



Deep Cycle Battery FAQ -concise

- http://www.windsun.com/Batteries/Battery_FAQ.htm

Battery University – in-depth information on all battery types but requires a little more digging

- <http://batteryuniversity.com/>