Date: 1-1-12

A 33Ah battery near full charge, charged by 40+60 Watt solar panel. The battery is connected to an inverter and it is used to power a laptop.

start time: 18:50 hours

Time	Battery_voltage	Corrected_Voltage	Load type
18:50	12.60V	12.34V	laptop browsing
19:10	12.40V	12.15V	laptop browsing
19:22	12.34V	12.09V	laptop mostly at rest
19:40	12.25V	12.01V	laptop at rest
20:00	12.25V	12.01V	laptop browsing
20:05	12.22V	11.98V	laptop at rest

break upto 21:10

21:10	12.16V	11.92V	
21:40	12.13V	11.89V	laptop browsing
22:10	12.10V	11.86V	laptop browsing
22:25	12.03V	11.79V	laptop browsing
22:40	11.96V	11.72V	laptop videos(low resolution)

Inverter fails to supply voltage after this, strange. It seems to cut off at a relativily higher voltage for low voltage condition. I need to check the inverter.
Introducing a correction of -2% of all the values. The multimeter was found defective.

2-1-2012

Discharging the same battery again. with the same faulty and unpredictable inverter. Charged good amount by a sunny sky by 40+60W panels . I think the battery is supplying 2A of current for laptop and 1A for broadband modem. This is assuming a considerable conversion loss in in the inverter side too. But I could be wrong. If it is 3A, it should approximately follow the C/3 curve as shown in the end of this document.

Time	Battery voltage	Load type
18:31	12.54V	laptop browsing+BB modem

Found a glaring fault in the connection to inverter just now! The inverter is connected to the battery by means of a long wire. There is a joint between the wires from the inverter and the wires from the battery. When the voltage is measured from in the joints, it is 1V lesser! Nearly 1V is dropped across the terminals. May be the same thing happened yesterday? I found previously that the inverter indicates low voltage at 10.8V. Yesterday the inverter was cut off at 11.72V.. was only 10.8V reaching the inverter causing it to shutdown? Need to confirm the same.

Time	Battery Voltage	Battery voltage at joint	Load type
18:59	12.38V	11.51V	Laptop document edit+BB modem DL
19:20	12.32V	11.44V	Laptop browsing + BB modem DL
19:47	12.22V	11.36V	Laptop browsing + BB modem DL
20:14	12.14V	11.30V	Laptop browsing+ BB modem DL
20:49	12.01V	11.12V	Laptop document edit + BB modem DL
21:20	11.86V	11.10V	Laptop most at rest + BB modem DL
21:42	11.82V	10.99V	Laptop mostly idle + BB modem DL
21:53	11.78V	10.64V	Laptop mostly idle + BB modem DL
22:11	11.71V	10.66V(!)	Laptop browsing + BB modem DL
22:30	11.62V	10.50V	Laptop video + BB modem DL
22:40	11.57V	10.46V	Laptop video + BB modem DL
22:46	11.54V	10.44V	Laptop video + BB modem DL
23:00	11.46	10.35V	Laptop video + BB modem DL

The inverter shutsdown at this point. Approximately it is 10.4V, a danger level for lead acid battery. The voltages highlighted in yellow are measured from a different point – inside the inverter, where the battery inputs touch the PCB of the inverter. Meanwhile, I have discovered that the AC ammeter which I use probably can be put to good use – its output value can be divided by √2 to get an approximate value of the DC current. Yipee!

Insights obtained:
I connected the ammeter to the battery after this.. and got some amazing results. I found that the inverter consumes about 1.05A of DC current from the battery in idle state! Such waste of power. The broadband modem, lesser then expected added 0.26A of load only. The printer added a load of 0.7A while in idle state and about 1.15A of load while in operation. It also spiked to about 3A occationally, especially while starting up. The laptop is the power guzzler here, and it added about 3A of DC load to the battery while charging and 1.6A of DC load to the battery while operating under AC load with a fully charged battery. Wonder how much conversion loss is introduced by inverter when the ouput demand increases. Only a good measurement in the output AC side will tell.

An combined stress provided by a combination of broadband modem and the laptop will likely have been about 3A for 5 hours.. which means that the battery is depleted about 15Ah of capacity.

More action
3-1-2011,00:54 hours: Currently I'm discharging at the rate of 2A. The battery voltage is at 11.34V. broadband modem and a series combination of 3X3W LEDs. I think I should leave it for another 6 hours. That could leave the battery gasping for breath as it will discharge another 10A. DoD 75%!

3-1-2011:

Good morning this one. Clear skies still. Yesterday's load seems to have discharged the battery to below the 10.4 mark. As a result, the charge controller seems to have cut off the supply to the LEDs which I had connected. Today, I'm going to measure the amps given by the solar panels using the 5A AC ammeter(value/ √2 to get DC value). I should soon buy another 5A ammeter to measure currents above 3.5A.

Time	**Charging current**	**Battery voltage**
08:05	1.12A	12.25V
08:52	1.95A	12.40V
09:20	2.09A	12.45V
11:00	2.18A	12.66V
15:00	2.10A	13.01
16:30	2.96A	13.23V
17:00	1A	-

Funny, right from 09:20-11:00 AM, the current drawn by the charge controller is very less... even though the short circuit current given by the panel is about 5.74A. Could there be any problem with the charge controller?
I found it, the problem is not with the charge controller, but it is with the long wires connecting the panel to the charge controller – there is a HUGE drop of 5—6V which results in the solar panels operating 18.7V, which is above the rated voltage of 17V. Hence the current output was very less.

The charging time is over; the panels are giving a poor output now; the shadow of a partially torn wall is falling due to the 5'0 clock inclination of the sun. I'm starting discharging now at 17:00 hours

Time	Battery voltage V	Battery current output, A	Load type
17:00	12.50	4.24	Laptop charging
17:11	12.46	2.12	Laptop browsing + BB modem DL
No conduction upto 1755 hours			
17:55	12.28	4.59	Laptop charging +BB modem
18:05	12.26	4.1	Laptop charging

18:20	12.20	2.121	
18:21	12.05	5.65	1 laptop charging, 1 laptop brow, 1 BB DL
18:46	12.03	2.82	1laptop NU,1 BB UL
19:23	11.82	2.82	1laptop video, BB modem UL
No supply upto 19:39 hours.			
20:15	11.49	2.82	1 laptop video, BB modem UL
End of supply at 20:19 due to low voltage.			

I am not very confident of the 0-10 Amp AC ammeter I'm using. It seems inaccurate for low voltages. Showing lower than 0-5A for values upto 4A.
Replaced the 10Amp AC ammeter with the 5A one.. this one is showing higher reading... but what truly is the correct value? Only a legitimate DC ammeter can tell. But for now, I'm considering that my 5A AC ammeter is more accurate.
Battery seems to fizzle out quite easily today.. of course, the charge given by the solar panel was appalling today.
The inverter refuses to supply power after this, perhaps due to the poor joints made in the ammeter. Howerver, I'm not going to correct that today. Its enough for today. I might use the remaining power to power some LEDs as light supply during night.

4-1-2011

Another sunny day it seems to be. I've tilted the panels about 20º to meet the sun. Let us see how the charging takes place today. I'm going to make a 45 minute interval note of the charging and the charging rate. I'm using the AC ammeter, which gives really low values from 0-3A. I don't know any other alternative.

Time	Battery Voltage	Input current	comments
08:30	12.5	0.8	Inaccurate current
10:23	13.4	3.6	Inaccurate current

Strange. At 10:30, battery says that it is under almost full charge(13.4V, while float charge is 13.6V). Could I be getting the charge curve wrong? Need to see more. Need to see when the charge controller will cut off the battery.
The solar charge controller cut off the battery when it was 14V(13.72V across the battery due to drops in the wires.
I operated the battery for an hour and it supplied about 3A of current and the voltage dropped from 12.74-12.5V ... battery doesnt seem too bad.. better check it out full after a full charge.
17:00 hours: The battery has been under full charge since 15:00, if I go by the fact that it has been

above the float voltage consistently. Ive been using the inverter since that, powering my laptop purely by solar panel. The panels are under shadow now and the battery has started to pump in more power relatively. Im monitoring the discharge.

Time	Battery voltage(V)	Battery current (wrong reading) A	Solar input?	comments
17:00	12.97	2√2	Yes(1/√2)	All current meassurements are wrong as they are (AC ammeter readings)/√2
17:31	12.82	2.47	Yes(<1)	
18:21	12.57	2√2	Yes(<1)	
19:10	12.34	2√2	No	
19:48	12.22	2.47	No	
20:10	12.12	2.47	No	
Break from 20:15-20:50				
20:50	12.10	3.1	-	**Got a DC ammeter!!**
21:22	11.88	2.9	-	Big drop?
22:08	11.62	2.9	-	
22:50	11.01	2.8	-	Another 20 min perhaps
22:57	10.47	2.8	-	(embarassed 7/20)

Got appa to buy a DC ammeter.. he knew where it could be found. The readings are a revelation. The current used by the inverter for supplying the laptop is about 2.1A (AC power, now battery chargin) and for itself is about 0.9A while ON and 0.15A while idle but connected.

@22:57PM: The battery has given it all. Its voltage is 10.4, which is the danger level and the inverter has turned it off. Approximate amps pumped out is only 15Ah, which is very less than the actual capacity of 35Ah (-x Ah, as some acid has spilled)

5-1-2011

Some study from www.batteryuniversity.com was a revelation. I was weofully poor in understanding how a lead acid battery works. Apparently, a battery needs to be put into two stages of charging: a constant current charge(first 70%) and a constant voltage(last 30%) charging. My battery was passing thorough the constant current charge phase reasulting in a voltage excess of 13.6V and then reaching out to constant voltage charge phase. But I did not know such a phase existed. Need to look more in this.

Diagrams and other data: